DOCUMENT RESUME

ED 280 702 SE 047 864

AUTHOR Colgren, John
TITLE The Computer Revolution. An Introduction to Computers. A Good Apple Activity Book for Grades 4-8.
REPORT NO ISBN-0-86653-067-3
PUB DATE 82
NOTE 74p.
AVAILABLE FROM Good Apple, Inc., P.O. Box 299, Carthage, IL 62321-0299 ($5.95; GA421).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Computers; Elementary Education; Instructional Materials; *Learning Activities; *Mathematics Instruction; Number Systems; *Programing; Teaching Methods; *Units of Study; *Workbooks
IDENTIFIERS *BASIC Programing Language

ABSTRACT

This booklet is designed to introduce computers to children. A letter to parents is provided, explaining that a unit on computers will be taught which will discuss the major parts of the computer and programming in the computer language BASIC. Suggestions for teachers provide information on starting, the binary system, base two worksheet, binary cards, mind-reading cards, "Napier's Bones," the "Human Computer," and programming; award certificates and an answer key are also included. The student booklet has sections on what computers are, the beginning and history of computers, computer components, flow charts, and programming. (MNS)

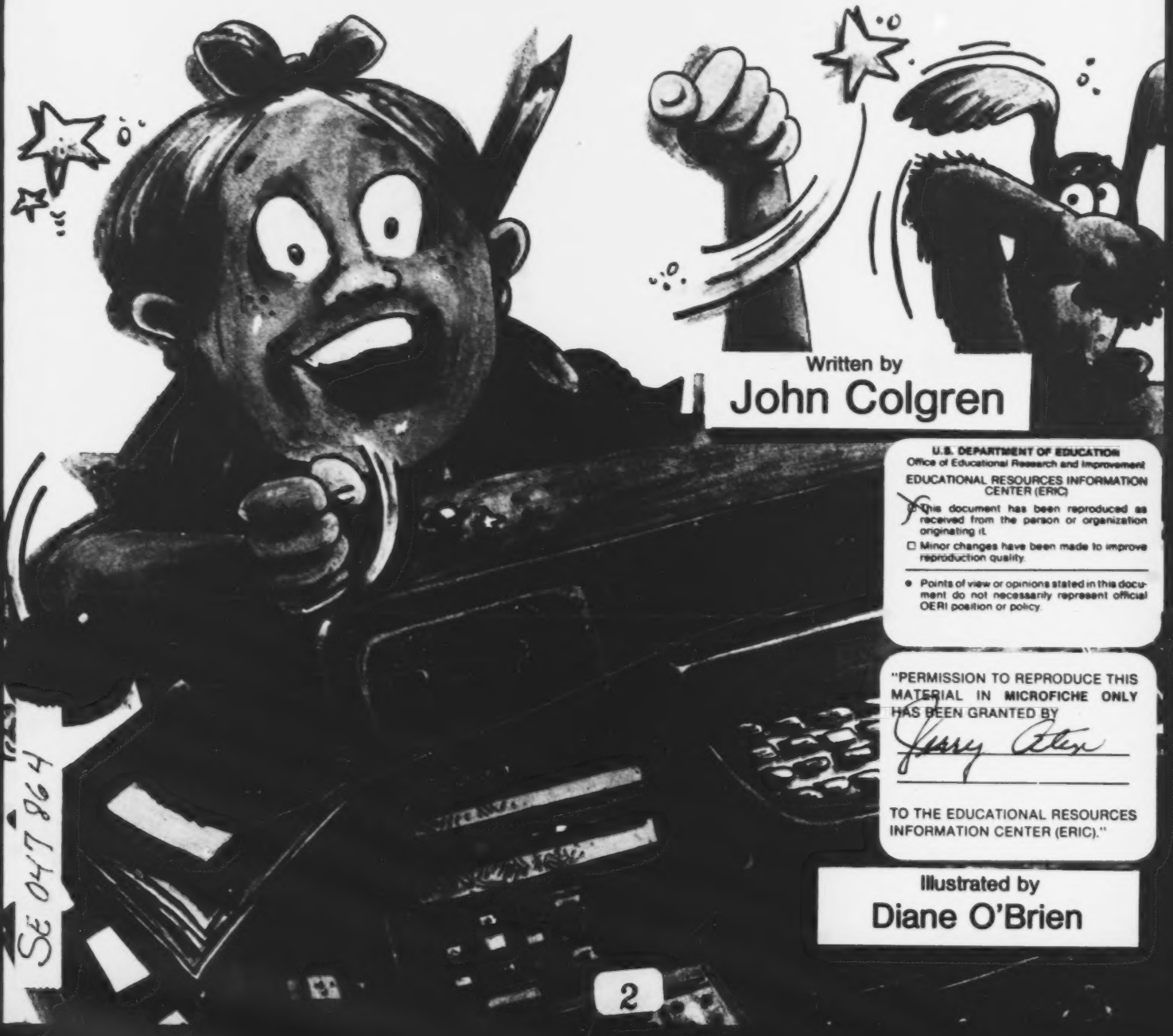
****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

A Good Apple Activity Book for Grades 4-8

ED280702

The COMPUTER REVOLUTION

An Introduction to Computers



Written by
John Colgren

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Jerry Aten

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Illustrated by
Diane O'Brien

SE 047 864

THE COMPUTER REVOLUTION

By

JOHN COLGREN

illustrated by Diane O'Brien

Cover by Mark Dittmar

Copyright © Good Apple, Inc., 1982

ISBN No. 0-86653-067-3

Printing No. 9876543

GOOD APPLE, INC.
BOX 299
CARTHAGE, IL 62321-0299

The purchase of this book entitles the buyer to duplicate the student activity pages as needed, for use by students in the buyer's classroom. Permission for any other use must be granted by Good Apple, Inc.

All Rights Reserved - Printed in the United States of America by Crest Litho Inc., Albany, NY

TABLE OF CONTENTS

Part One: Teacher Reference **Pages**

To the Teacher iii
Parent Letter iv
Computers • A Starting Point 1-4
The Binary System 5-6
Base Two Work Sheet 7
The Binary Cards 8-9
The Mind Reading Cards 10-15
Napier's Bones 16-19
The "Human Computer" 20-22
Programming 23-25
Award Certificates 26-28
Answer Key 29

Part Two: Student Book

Computers--What Are They? 1-6
Computers--The Beginning 7-10
History 11-16
Computer Components 17-22
Flow Charts 23-25
Programming in BASIC 26-30

To the Teacher . . .

Computers have been on the scene for just over thirty years. A short period of time, but oh, what an influence they have had! Every single day we have contact with products and services that have, in some fashion, been influenced by computers. Bills, form letters in the mail, checks, labels on groceries, and sales tickets on consumer products are all examples of computer involvement. The startling thing is that this represents only the earlier years of the computer revolution. The field is ever expanding and will continue to have more and more of a role in our lives. Soon, having a home computer system will be as common as owning a color TV set is now. The cost of individual home systems is steadily going down as advancements are made in cutting production costs and as the demand increases. But even if a person never owns a system of his own, his life will have been touched by computers in so many other ways.

It is time for people to be prepared with some computer understanding so that they may look to the future with hope and vision. An introduction to computers--their history, components, capabilities, and limitations would benefit most people. There is no reason for not offering such a program as part of our school curriculum at any grade level. It is important to acquaint our students with this topic. They will approach the subject with great enthusiasm and interest. It is their future--let's prepare them for the best.

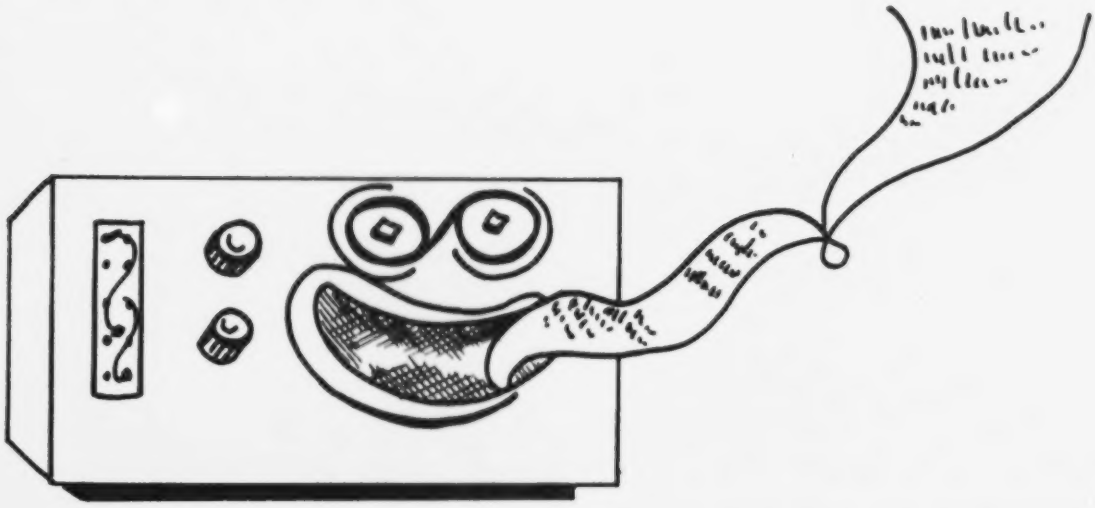
Dear Parents,

Computers have had a tremendous influence on our world. Every day their role and degree of importance increases. With this ever-expanding dependence, there becomes the need for greater computer education. Many people have confusions or misconceptions with regard to what the computer revolution means. An understanding of what a computer is, as well as its strengths and weaknesses, would benefit anyone.

With this in mind, we have selected a unit on computers as the topic of study for your child. The unit will discuss the major parts of the computer system and programming in the computer language "BASIC."

The material of this unit is not easy, so we would welcome any assistance and encouragement you can give your child. It is our hope that this unit will provide a clear picture of what computers are and possibly a glimpse as to what the future holds.

Sincerely,



COMPUTERS *A STARTING POINT

Suggestions for use of the material: Note--Some materials are meant for teacher reference and some are meant to be duplicated for the student to work with and keep.

1. Electronic computers owe everything to a number system developed a very long time ago called base two. An explanation of the base two or binary system is essential to understanding how a machine of this type could operate.

(a) Present a lesson on the binary system including examples at the board of base two place value and how this compares to base ten. Have students practice converting from one base to the other.

(b) Give examples of addition, subtraction, and multiplication in base two.

(c) Use Binary Cards and Mind Reading Cards at different times during the week. Don't mention any connection with base two and see if anyone can discover a connection.

(d) Give the base two work sheet.

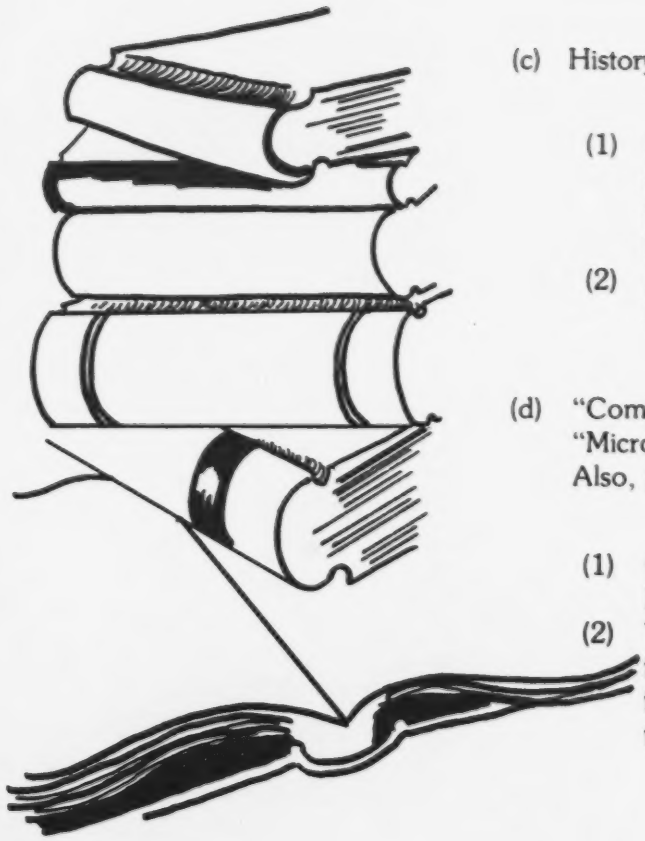
(e) Set up the "Human Computer" and demonstrate how it can be used to add. Once students see how this works, challenge them to figure out how to multiply with it. Let them experiment and ponder over this for a few days.

2. With an understanding of base two, it is now time to hand out the student booklets. To avoid students going ahead, you may want to hand out these materials page by page when they are called for.

(a) Cover and pages 1-5, "Computers--What Are They?"

(1) Be sure to emphasize the relationship of man to computer--creative force vs. electrical speed and accuracy.
(2) Assign first "Computer Challenge" and occasionally have students share what they have found.

(b) "Computers--The Beginning"--Use directions for construction of a simple abacus and pages 7-10 of student book.



(c) History of computers continues with pages 11-16.

(1) Contrast ENIAC which would have filled a typical school library with the microcomputers of today which are not much bigger than a briefcase.
(2) Assign "What Will the Future Hold?" page 16.

(d) "Computer Components," pages 17-18
"Microcomputer Components," page 19
Also, pages 20-22 for input and output equipment

(1) Go through the flow chart for "Taking a Bath," page 23.
(2) Then use page 24. Students follow the flow chart directions. See if anyone can figure out that this is a flow chart to add two numbers together.

(3) Page 25 is another challenge. Allow a few days for completion. Then borrow play phones from the kindergarten and test each other's work.

(e) Programming in BASIC--

(1) Refer to teacher references on programming.
Do some work at the board before handing out student pages 26-28.

(2) Page 28 refers to the program at the bottom of page 27. Solution would be:

```
10 PRINT "ADDITION OF TWO
   NUMBERS"
20 INPUT Y,Z
30 LET W=Y+Z
40 PRINT W
45 GO TO 20
50 END
```

(3) Pages 29 and 30--four more challenges for program writing

(4) Of course, the ideal situation would be to arrange an opportunity to have students run one of their programs on a computer. Check around and see what is available; BASIC is a very popular language. Most high schools have a computer system; many homes now have microcomputers. Maybe even a local company will offer your students some time. It is usually not difficult to locate a willing source for computer time.

NOTE: Hand out award certificates when a student has demonstrated an understanding for or competency in a specific area.

Binary Number System
Parts of a Computer System
Abacus
Flow Charting
Programming

THE BINARY SYSTEM--Base Two

We are accustomed to the decimal system, or base ten,as we use it every day. But there are other bases, too. Each is set up in the same fashion only with different place values. Here is a comparison of some bases.

Base Ten

10,000's	1,000's	100's	10's	1's
		3	0	2

302_{10}

Base Four

1024's	256's	64's	16's	4's	1's
	1	0	2	3	2

10232_4

Base Sixty

3600's	60's	1's
	5	2

52_{60}

All three of these represent the same amount. They are written in three different bases. It might seem strange to see other bases, but we do have contact every day with two of these shown above--base ten in our exchange of money and base sixty with our time calculation. The small number to the right indicates what base we are dealing with.

Base two was developed a long time before computers. At that time, there was no logical use for it, so its developer was ridiculed. However, without base two, computers would never have had a chance. In base two there are only two digits, 0 and 1. These digits can be used to represent all numbers. For instance, 3 is written 11_2 and is read one one base two. One group of two and one one give three base ten.

8's	4's	2's	1's
		1	1

Here is a portion of the place values in base two and a few numbers to show how it works.

32's	16's	8's	4's	2's	1's	
			1	0	1	$_2 = 5_{10}$
		1	0	1	1	$_2 = 11_{10}$
	1	1	1	0	0	$_2 = 28_{10}$
1	0	0	0	0	0	$_2 = 32_{10}$
	1	0	1	0	1	$_2 = 21_{10}$

11

In base two, there are only two possibilities or conditions, 0 or 1. This can be compared to a switch that can be either "on" or "off" or magnetism which can either be in one direction or the other. Base two can be applied to these conditions. An "off" switch can mean "0" and an "on" can mean "1." In this way, a machine can be used to represent numbers in base two.

As a demonstration, use the classroom lights to represent some numbers. There should be at least three rows of lights in the room with each row working off of a separate switch. Identify one row as the 1's column, the next row as the 2's column, and the third row as the 4's column. Now, by switching the light switches appropriately, you can represent numbers from 0 to 7. Have the students guess what numbers are being represented.

Arithmetic Operations in Base Two

Adding

$$\begin{array}{r} 101_2 \\ +\ 11_2 \\ \hline 1000_2 \end{array} \quad \begin{array}{r} = 5 \\ = +\ 3 \\ \hline 8 \end{array}$$

$$\begin{array}{r} 1011_2 \\ +\ 101_2 \\ \hline 10000_2 \end{array} \quad \begin{array}{r} = 11 \\ = +\ 5 \\ \hline 16 \end{array}$$

Analysis:

$$\begin{array}{r} 1 \\ +\ 1 \\ \hline 10 \end{array}$$

only 2 numbers in base 2

So 1 plus 1 is written 10.

Zero is in 1's place and 1 is carried over to 2's place.

Subtracting

$$\begin{array}{r} 101_2 \\ -\ 11_2 \\ \hline 10_2 \end{array} \quad \begin{array}{r} = 5 \\ = -\ 3 \\ \hline 2 \end{array}$$

$$\begin{array}{r} 1011_2 \\ -\ 101_2 \\ \hline 110_2 \end{array} \quad \begin{array}{r} = 11 \\ = -\ 5 \\ \hline 6 \end{array}$$

Multiplying

$$\begin{array}{r} 101_2 \\ \times\ 11_2 \\ \hline 101 \\ 101 \\ \hline 1111_2 \end{array} \quad \begin{array}{r} = 5 \\ = \times\ 3 \\ \hline 15 \end{array}$$

$$\begin{array}{r} 1011_2 \\ \times\ 101_2 \\ \hline 1011 \\ 0000 \\ 1011 \\ \hline 110111_2 \end{array} \quad \begin{array}{r} = 11 \\ = \times\ 5 \\ \hline 55 \end{array}$$

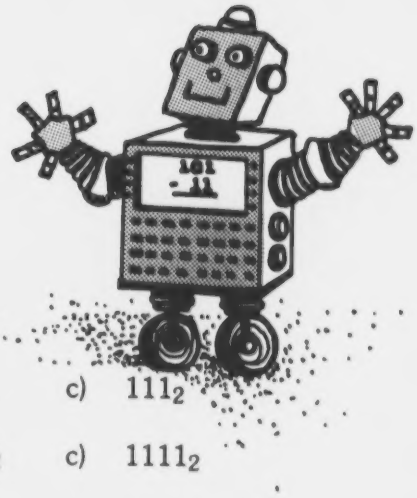
_____ Shifting is the basis of this process.

Division

$$101_2 \overline{)\ 11010}$$

$$\begin{array}{r} 101\ \text{R}\ 1 \\ 101 \\ \hline 11 \\ 000 \\ \hline 110 \\ 101 \\ \hline 1 \end{array}$$

101_2 BASE TWO WORK SHEET



Multiple Choice

A. Change these base ten numbers to base two equivalents:

1) 7_{10} = _____$_2$ a) 11_2 b) 101_2 c) 111_2

2) 13_{10} = _____$_2$ a) 110_2 b) 1101_2 c) 1111_2

3) 10_{10} = _____$_2$ a) 101_2 b) 1010_2 c) 1011_2

B. Change these base two numbers to base ten.

1) 1111_2 = _____$_{10}$ a) 15 b) 23 c) 13

2) 1011_2 = _____$_{10}$ a) 13 b) 12 c) 11

3) 10111_2 = _____$_{10}$ a) 23 b) 25 c) 19

Problems

C. Add in base two. (Check your answers in base ten.)

1) 101_2 + 11_2

2) 1101_2 + 111_2

3) 10111_2 + 1011_2

D. Subtract in base two.

1) 1101 − 110

2) 1110 − 111

3) 101 − 11

E. Multiply in base two.

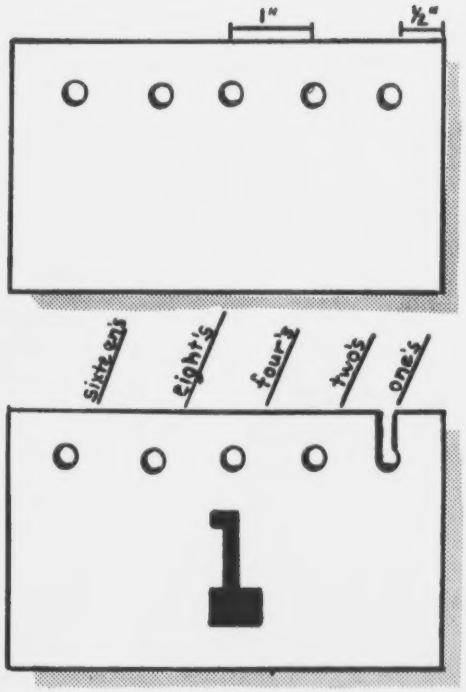
1) 101 × 11

2) 1101 × 111

3) 1111 × 101

THE BINARY CARDS

Materials: thirty 3 x 5 cards
paper punch
scissors
straightened paper clip



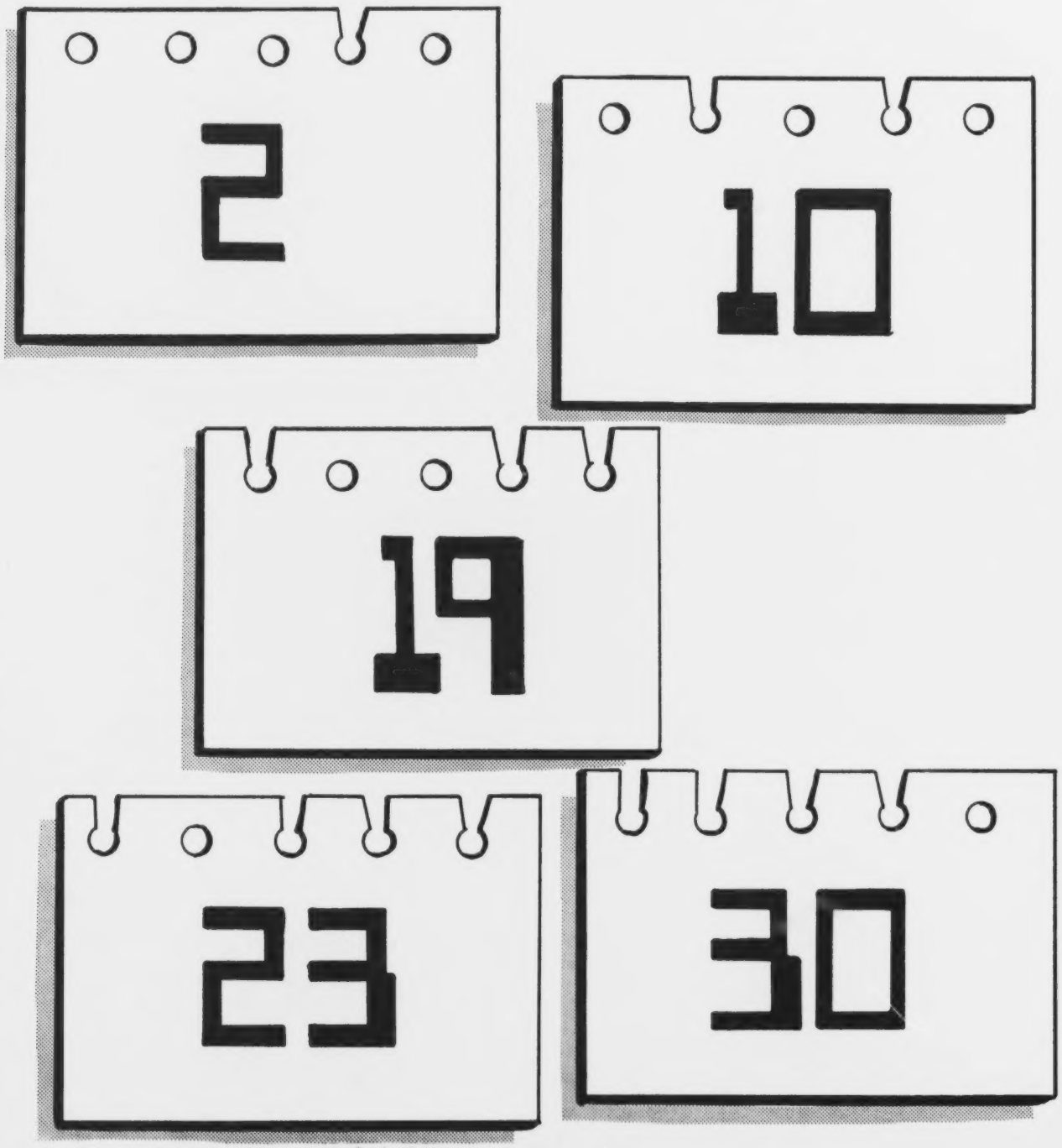
1. Five holes will be punched in each card.
   (a) The holes will run in a straight line approximately ½ inch from the top of the card.
   (b) Start the first hole ½ inch from the right side.
   (c) Measure other holes from the center of the previous hole. From center to center measure one inch.

2. Now, write a number on each card from 1 to 30.

3. To have each card represent the number written on it, you will use scissors and a trick of base two.
   (a) In base two there are two conditions, either a zero or a one. So represent a zero with an uncut complete hole and a one with a cut hole.
   (b) Now, the five holes across the top of each card will become place value indicators.
   (c) For each card use the scissors to cut the appropriate holes to represent the number on the card.

4. To perform the demonstration do the following:
   (a) Be sure all cards are arranged so that sides with numbers written on them are facing the same way and are upright.
   (b) Have a student shuffle the cards well.
   (c) Hold the cards together with the holes lined up.
   (d) Now, starting at the hole to the far right with the cards facing you, stick the paper clip through all the cards. With an up-and-down jiggling motion, move the paper clip up until cards that have been cut fall through. The cards that fall through are kept in the order in which they fall and then added to the back of the deck. This process is continued with the other holes, one by one, all the way across from right to left.
   (e) When the last hole on the far left has had its turn with the paper clip, the cards can be reviewed to see that they are in order.

All numbers can be shown in base two and in this pattern of either a complete hole or a cut hole. Examination of the individual cards shows how each numbered card has been prepared to meet the conditions of base two.



THE MIND READING CARDS

Materials: 5 Mind Reading Cards

Procedure: Tape the 5 cards in order from A to E onto the chalkboard. Then, with your back to the cards, ask a student to think of a number between 1 and 31. Once the student acknowledges that a number has been selected, ask him/her to tell out loud the letters of the cards on which the number appears. You can determine the number that the student was thinking of by using what you know about base two.

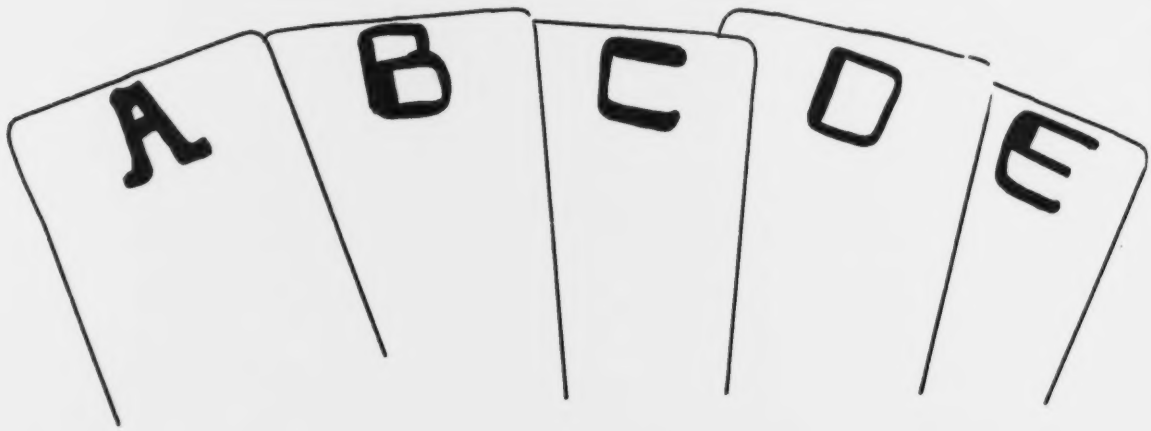
Solution: The cards have been prepared with use of base two.

Card A stands	for the 1's place
Card B	2's
Card C	4's
Card D	8's
Card E	16's

The number in the upper left-hand corner of the 4 x 5 table on each card is the place value of that card. By adding those place value numbers together, the mystery number can be found.

Example: A student thinks of the number 12. He/She calls out the letters C and D because those are the only two cards 12 appears on. Card C stands for 4 and Card D stands for 8. Add these two numbers and you get 12.

If you remember that Card A is 1, Card B is 2, Card C is 4, Card D is 8, and Card E is 6, then all of this can be done in your head with your back to the cards. This will truly amaze your students until it has been done enough times for someone to figure out the solution.



16

A

1	3	5	7	9
11	13	15	17	19
21	23	25	27	29
31				

B

2	3	6	7	10
11	14	15	18	19
22	23	26	27	30
31				

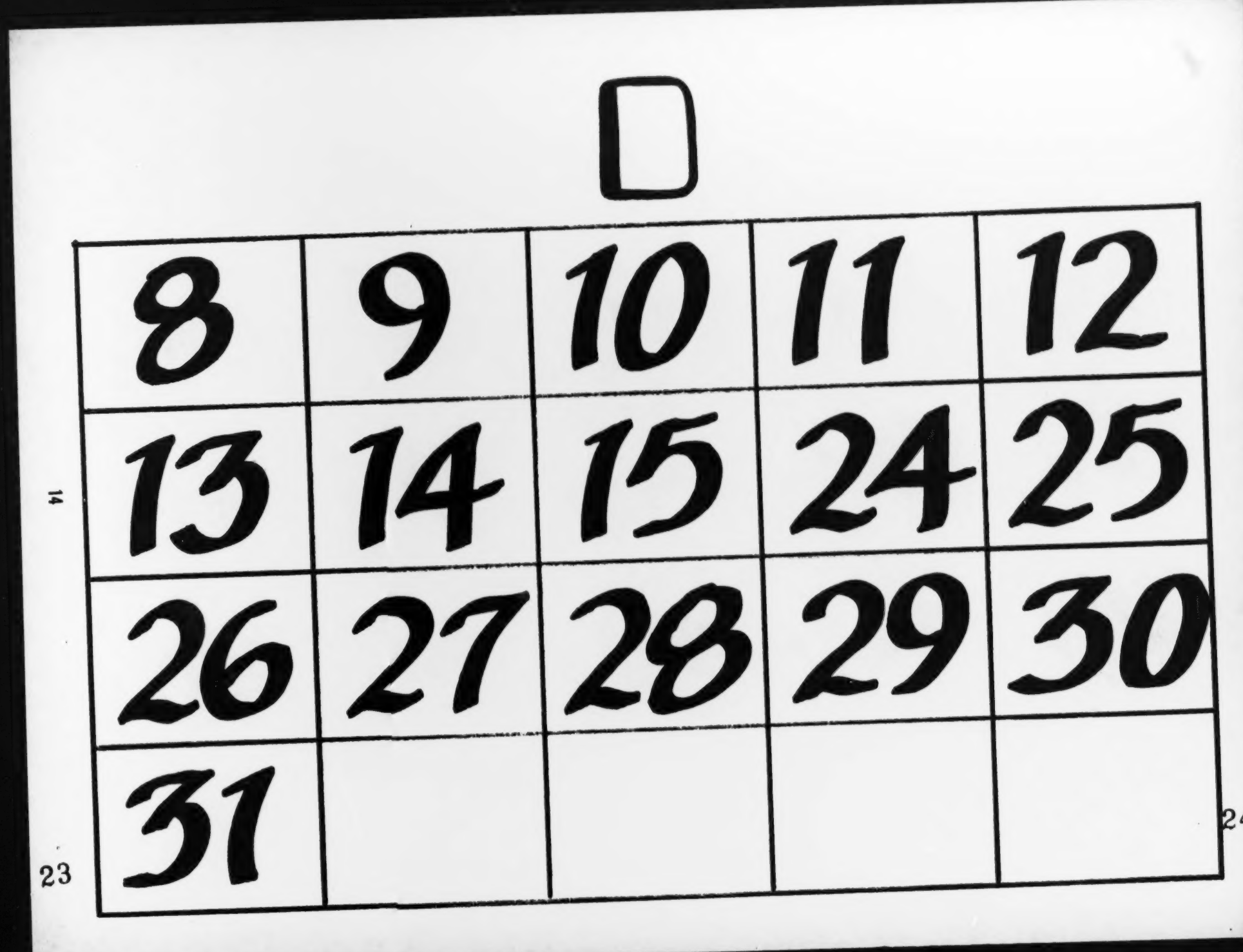
12

19

20

C

4	5	6	7	12
13	14	15	20	21
22	23	28	29	30
31				


8 9 10 11 12
13 14 15 24 25
26 27 28 29 30
31
14
23
24

E

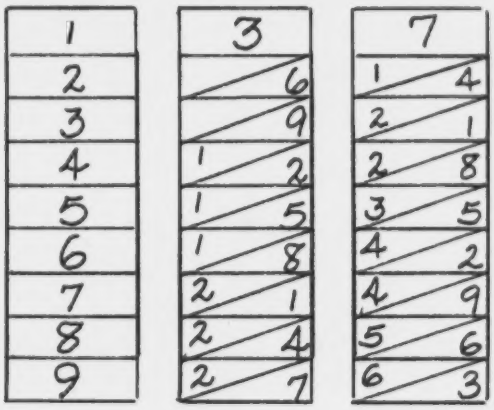
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31				

NAPIER'S BONES

Materials: set of Napier's bones (10)

Procedure: In the year 1617, John Napier invented a multiplication machine that was later referred to as Napier's Bones. With the 10 bones, any multiplication problem could be solved quickly.

The bones consist of one key (numbers 1 through 9) and nine other bones, each with one of the digits 1-9 on it. The digit cards also include the multiples for that digit.

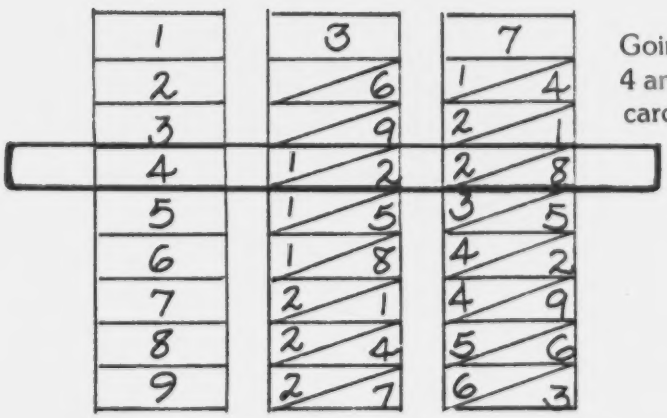


Key | Multiplier Card for 3 | Multiplier Card for 7

When multiplying two numbers, such as 5 x 3, line up the key and the 3 card. Move down the key card to 5 and then straight across, you come to the answer 15.

Two-digit numbers may also be multiplied with the bones. For example:

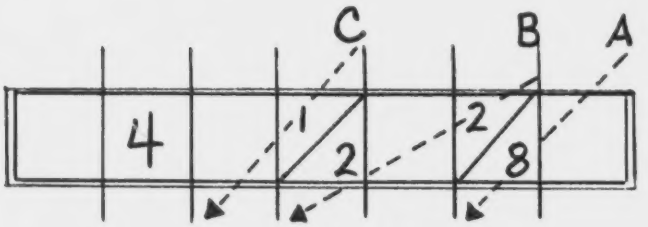
$$\begin{array}{r} 37 \\ \times\ 4 \\ \hline 148 \end{array}$$



Going down the key card to 4 and then across to the 3 and 7 cards, we see this.

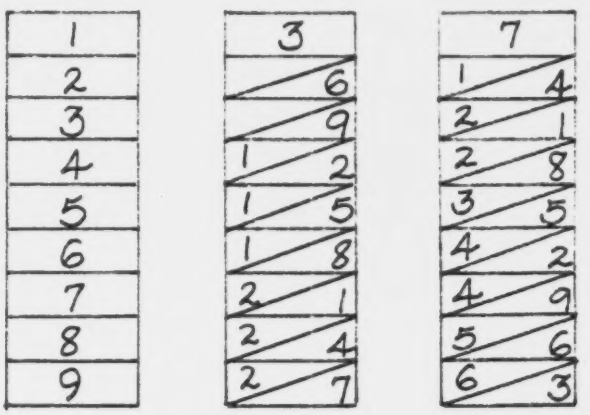
The 3 card and the 7 card are lined up together and then brought to the key card.

Here is a close-up of what we find.



To get an answer, we start at A and record the number there in the 1's place. At B, we find two numbers in line so they are added to get 4. The result of B will be placed in the 10's place of the answer. At C, there is only one digit and it will be in the 100's place. So the answer for 37 × 4 is 148.

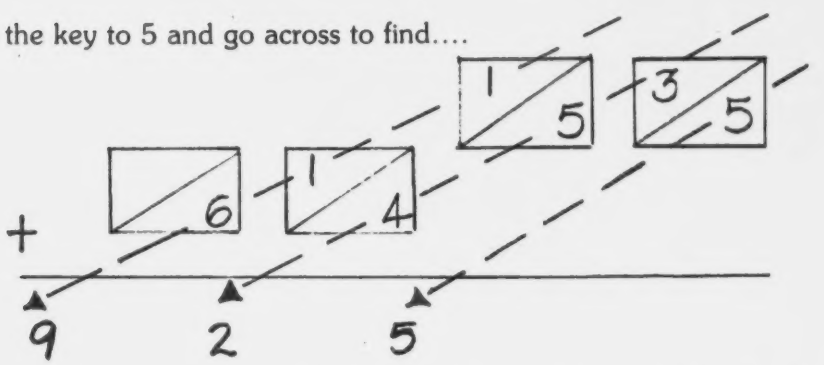
Two 2-digit numbers can be multiplied as follows:



$$\begin{array}{r} 37 \\ \times\ 25 \\ \hline \end{array}$$

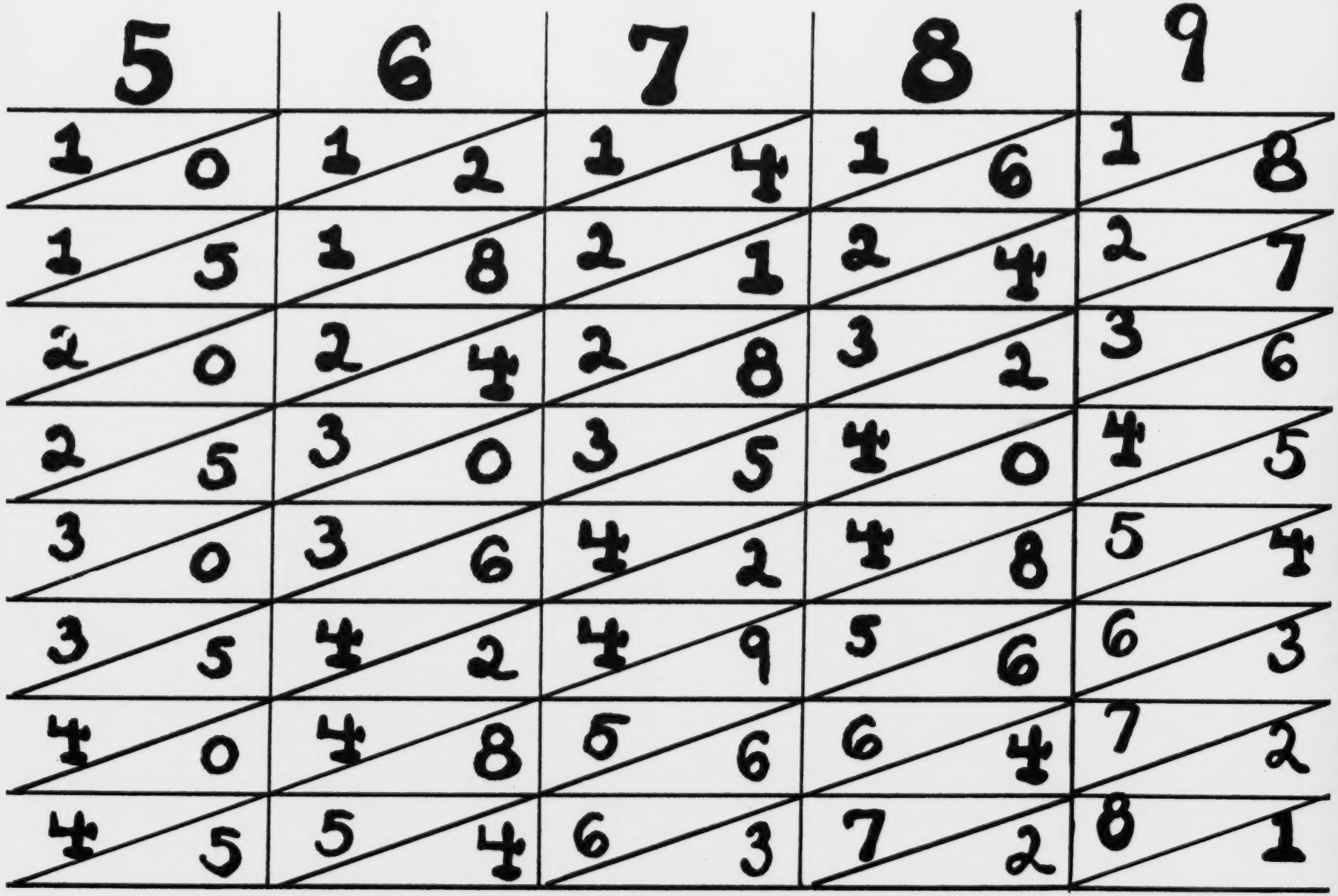
The 5 is in the 1's place so work with that first.

Slide down the key to 5 and go across to find....



The 2 is in the 10's place, so it will be shifted over one place to the left. Go down the key to 2 and look across.

Key	1	2	3	4
2	2	4	6	8
3	3	6	9	12
4	4	8	12	16
5	5	10	15	20
6	6	12	18	24
7	7	14	21	28
8	8	16	24	32
9	9	18	27	36


5
6
7
8
9
10
12
14
16
18
15
18
21
24
27
20
24
28
32
36
25
30
35
40
45
30
36
42
48
54
35
42
49
56
63
40
48
56
64
72
45
54
63
72
81
50
60
70
80
90
55
66
77
88
99
60
72
84
96
108
65
78
91
104
117
70
84
98
112
126
75
90
105
120
135
80
96
112
128
144
85
102
119
136
153
90
108
126
144
162
95
114
133
152
171
100
120
140
160
180
105
126
147
168
189
110
132
154
176
198
115
138
161
184
207
120
144
168
192
216
125
150
175
200
225
130
156
182
208
234
135
162
189
216
243
140
168
196
224
252
145
174
203
232
261
150
180
210
240
270
155
186
217
248
279
160
192
224
256
288
165
198
231
264
297
170
204
238
272
306
175
210
245
280
315
180
216
252
288
324
185
222
259
296
333
190
228
266
304
342
195
234
273
312
351
200
240
280
320
360
205
246
287
328
369
210
252
294
336
378
215
258
301
344
387
220
264
308
352
396
225
270
315
360
405
230
276
322
368
414
235
282
329
376
423
240
288
336
384
432
245
294
343
392
441
250
300
350
400
450
255
306
357
408
459
260
312
364
416
468
265
318
371
424
477
270
324
378
432
486
275
330
385
440
495
280
336
392
448
504
285
342
399
456
513
290
348
406
464
522
295
354
413
472
531
300
360
420
480
540
305
366
427
488
549
310
372
434
496
558
315
378
441
504
567
320
384
448
512
576
325
390
455
520
585
330
396
462
528
594
335
402
469
536
603
340
408
476
544
612
345
414
483
552
621
350
420
490
560
630
355
426
497
568
639
360
432
504
576
648
365
438
511
584
657
370
444
518
592
666
375
450
525
600
675
380
456
532
608
684
385
462
539
616
693
390
468
546
624
702
395
474
553
632
711
400
480
560
640
720
405
486
567
648
729
410
492
574
656
738
415
498
581
664
747
420
504
588
672
756
425
510
595
680
765
430
516
602
688
774
435
522
609
696
783
440
528
616
704
792
445
534
623
712
801
450
540
630
720
810
455
546
637
728
819
460
552
644
736
828
465
558
651
744
837
470
564
658
752
846
475
570
665
760
855
480
576
672
768
864
485
582
679
776
873
490
588
686
784
882
495
594
693
792
891
500
600
700
800
900
505
606
707
808
909
510
612
714
816
918
515
618
721
824
927
520
624
728
832
936
525
630
735
840
945
530
636
742
848
954
535
642
749
856
963
540
648
756
864
972
545
654
763
872
981
550
660
770
880
990
555
666
777
888
999
560
672
784
896
1008
565
678
791
904
1017
570
684
798
912
1026
575
690
805
920
1035
580
696
812
928
1044
585
702
819
936
1053
590
708
826
944
1062
595
714
833
952
1071
600
720
840
960
1080
605
726
847
968
1089
610
732
854
976
1098
615
738
861
984
1107
620
744
868
992
1116
625
750
875
1000
1125
630
756
882
1008
1134
635
762
889
1016
1143
640
768
896
1024
1152
645
774
903
1032
1161
650
780
910
1040
1170
655
786
917
1048
1179
660
792
924
1056
1188
665
798
931
1064
1197
670
804
938
1072
1206
675
810
945
1080
1215
680
816
952
1088
1224
685
822
959
1096
1233
690
828
966
1104
1242
695
834
973
1112
1251
700
840
980
1120
1260
705
846
987
1128
1269
710
852
994
1136
1278
715
858
1001
1144
1287
720
864
1008
1152
1296
725
870
1015
1160
1305
730
876
1022
1168
1314
735
882
1029
1176
1323
740
888
1036
1184
1332
745
894
1043
1192
1341
750
900
1050
1200
1350
755
906
1057
1208
1359
760
912
1064
1216
1368
765
918
1071
1224
1377
770
924
1078
1232
1386
775
930
1085
1240
1395
780
936
1092
1248
1404
785
942
1099
1256
1413
790
948
1106
1264
1422
795
954
1113
1272
1431
800
960
1120
1280
1440
805
966
1127
1288
1449
810
972
1134
1296
1458
815
978
1141
1304
1467
820
984
1148
1312
1476
825
990
1155
1320
1485
830
996
1162
1328
1494
835
1002
1169
1336
1503
840
1008
1176
1344
1512
845
1014
1183
1352
1521
850
1020
1190
1360
1530
855
1026
1197
1368
1539
860
1032
1204
1376
1548
865
1038
1211
1384
1557
870
1044
1218
1392
1566
875
1050
1225
1400
1575
880
1056
1232
1408
1584
885
1062
1239
1416
1593
890
1068
1246
1424
1602
895
1074
1253
1432
1611
900
1080
1260
1440
1620
905
1086
1267
1448
1629
910
1092
1274
1456
1638
915
1098
1281
1464
1647
920
1104
1288
1472
1656
925
1110
1295
1480
1665
930
1116
1302
1488
1674
935
1122
1309
1496
1683
940
1128
1316
1504
1692
945
1134
1323
1512
1701
950
1140
1330
1520
1710
955
1146
1337
1528
1719
960
1152
1344
1536
1728
965
1158
1351
1544
1737
970
1164
1358
1552
1746
975
1170
1365
1560
1755
980
1176
1372
1568
1764
985
1182
1379
1576
1773
990
1188
1386
1584
1782
995
1194
1393
1592
1791
1000
1200
1400
1600
1800

THE "HUMAN COMPUTER"

Materials: Students--8 or more

Procedure: Computers make use of the binary or base two system. In this system, there are only two digits 0 and 1 that are used to represent all numbers. This system can be applied to computers as "on" or "off" switches or in other two-condition situations. To demonstrate how a computer goes through the arithmetic sequence using base two, build a "human computer."

The students will be representing numbers in base two, so two positions will be needed. The right arm of each student will do well. When the arm is down, it will mean 0 and when it is raised, it will register a 1.

Line four students up in a straight line to demonstrate. Each student will represent a different place value. You may want students to wear place value signs (pieces of paper with 0, 2, 4, and 8 written on them). The students start with their arms down. The rule is that when you are tapped on the left shoulder, you change the position of your right arm (if it is down and you are tapped, you raise it; if it is up, then lower it). However, when lowering your arm, you must tap the shoulder of the person to your right. So, with the students ready, tap a number into the computer. Tap the shoulder of the person in the 1's place. His arm will go up. Tap him again and his arm will go down but on the way down, he will tap the person next to him. In this fashion, numbers are entered into the "Human Computer" and are represented by 0's or 1's in specific place values.

This means 5 in base ten or 101 base two.

Adding with the "Human Computer"

To add two numbers with the "Human Computer," set up two rows of students, one in front of the other. One addend is placed in the front row, the other is put in the second row. On the signal "add" the students in the second row who have right arms raised will bring their hands down on the left shoulder of the person directly in front of them. The sum will now be shown in the front row.

Note: A person in the front row will have to be particularly alert because it is possible to be tapped twice, once from the side and once from the rear.

Multiplication with the "Human Computer"

The "Human Computer" can be used for multiplication, also. To understand how the students will have to shift, review the steps in base two multiplication.

Here is a problem.

Notice that as in other multiplication problems, there is a shift or series of shifts. This is the key to multiplication with the "Human Computer."

$$\begin{array}{rcr} 111_2 & = & 7_{10} \\ \times\ 101_2 & = & \times\ 5_{10} \\ \hline 111 & & 35_{10} \\ 000 & & \\ 111 & & \\ \hline 100011_2 & = & 35_{10} \end{array}$$

To do this same problem on the "Human Computer," the first number 111_2 is recorded into the back row of students. The front row is left blank.

Now the command "add" is given and the back row adds forward, causing the front row to respond with the result 111_2. At this point, the back row again raises their hands to record 111_2. The command "shift" is given and the back row moves one place to their right. Then because there is a zero in the next position of the multiplier (101_2), the command to "add" is not given. The back row, still with hands up, shifts again to the right and then adds to record the answer in the first row.

The rule is that after a shift, if there is a 1 in the multiplier, then add. If there is a 0 in that position of the multiplier, then don't add and shift again.

Subtraction with the "Human Computer"

Subtraction within a computer is accomplished through the use of complements. We can simulate this with our human computer. The complement method works as follows: Say we wish to subtract 13 from 20; this is how it looks in the decimal system.

```
  20   minuend
- 13   subtrahend
------
   7   difference
```

The minuend stays as is--20. The subtrahend will be changed to its complement and then added to the minuend. To find the complement of the base ten, we subtract each digit from 9.

13 (9 − 1 = 8, 9 − 3 = 6 -- so the complement of 13 is 86)

Then the one farthest to the left is dropped from its position and added to the 1's place.

This gives the answer, which is 7.

```
  20
+ 86
------
 (1)06
  +1
------
   7
```

In the binary system, we arrive at complements in the following fashion:

```
  20   =   10100    The minuend stays as is.
- 13   = - 1101     The subtrahead is changed to its complement.
```

To change a base two number to its complement, we simply change 1's to 0's and 0's to 1's. So, 1101 becomes 0010.

Now add

```
 10100
+ 0010
------
(1)0110
  +1
------
  111   = 7
```

As in base ten, the one farthest to the left is added to the 1's place.

To do this with the "Human Computer," the first row registers the minuend. The back row is given the subtrahend and then the command to complement. At this point, those in the back row with hands up, put them down, Those with hands down, put them up. When the complement is arrived at, the command "add is given and as always with addition, those with hands up in the back row tap the shoulders of the persons in front of them. The last step is to add one to the 1's place of the front row and to drop one to the farthest left.

PROGRAMMING

A computer can do a wide variety of tasks with great accuracy and speed but is helpless without a program. A program consists of instructions and information which tell the computer what to do, how to do it, and with what data. A program is written by a human. There are many program languages (COBOL, FORTRAN, PL/1, APL, BASIC). Each language provides a code that enables us to communicate with a computer. The computer language we will learn is called BASIC (Beginner's All-purpose Symbolic Instruction Code).

As in any language, there are certain procedures, words, and codes to learn before you can use it. Here are the basics for BASIC.

These are the symbols for arithmetic operations:

+	addition
–	subtraction
*	multiplication
/	division
"	exponents
( )	parentheses (used to indicate operations that are to be done first in an equation)

Variables (letters or letters and numbers) are used in the program to stand for data and answers.

Let's say we want to write a program that will multiply two numbers. Using variables, we write an equation such as A = B*C.

Now for the program. We need a way of getting information into the computer.

There are two input statements: READ and INPUT. READ B,C tells the computer to record values for the variables B and C from the DATA that follows at the end of the program. INPUT B,C tells the computer that values for B and C will be typed in by the programmer.

Each step in a program is called a line and needs to be identified by a line number. It is a good practice to use intervals of ten when assigning line numbers.

So, let's write up a program.

```
10    READ B,C
20    LET A = B*C
30    PRINT A
40    END
50    DATA 4,5
```

Line 20 gives the computer the equation.
Line 30 tells the computer to print out the value for A (A represents the answer for B*C).
Line 40 is a signal for the program to stop.
Line 50 is the instruction for supplying data--the 4 will be assigned to B, the 5 to C. Back at Line 20 (LET A = B*C) the computer would do A = 20.

Because Line 30 says to PRINT A, then all that the computer would type back for this program would be the value for A which is 20.

We can change this program slightly to solve many multiplication problems. If we add a new line after the PRINT statement to *loop* the program back to the beginning, we can have a program that multiplies a whole series of problems. The new line is the "GO TO" statement which sends the computer to another part of the program. We will assign the line number 35 and write the following: 35 GO TO 10. This will send the computer back to statement 10 where it is again told to READ new values for B and C.

Here's a new program.

```
10    READ B,C
20    LET A = B*C
30    GO TO 10
40    END
50    DATA 4,5,7,10,9,20
```

This is what would be printed back:

```
20
70
180
```

The computer automatically assigns values for B and C like this. First time through the program, B = 4 and C = 5. Second time, B = 7 and C = 10. Third time, B = 9 and C = 20. When all data has been used, the computer goes to Line 40 and stops.

Many times we would like things to be stated or printed out. The procedure is simple--anything within quotation marks will be printed.

Example: 30 PRINT "A =";A

This is what we would get as a print out:

A = 20

A = 70

A = 180

We could add to this in the following manner:

30 PRINT "B =";B, "C =";C, "A =";A

Here are the results.

B = 4	C = 5	A = 20
B = 7	C = 10	A = 70
B = 9	C = 20	A = 180

As you can see in each case, because we wanted the value for a variable, we had to write that variable after the statement in parentheses. A semicolon allows no spaces between things being printed. A comma causes columns to be formed. The comma causes a gap of 15 spaces.

IF--THEN Statement--This is a way to control and govern how long a loop will be. Here is a problem that counts from 1 to 20 and then stops.

```
100     I = 1
110     PRINT I
120     I = I + 1
130     IF I < 21 THEN 110
140     END
```

A comparison is made within an IF--THEN statement. Greater than, less than, or equal are utilized. In this last program, at 100 the integer I is given the value of 1. 110 PRINTS the current value of I. 120 increases the value of I by 1 to make it 2. 130 checks to see if I is less than 21. If it is less than 21, then go to 110 and print the current value of I which is 2.

This will continue until the value of I is 21 and then the program will stop. If a variable does not meet the conditions of the IF--THEN statement, then the computer goes on to the next line which in this case was END.

I KNOW THE BINARY NUMBER SYSTEM

...7=111...20=10100....

DATE: _____ AWARDED TO: _____

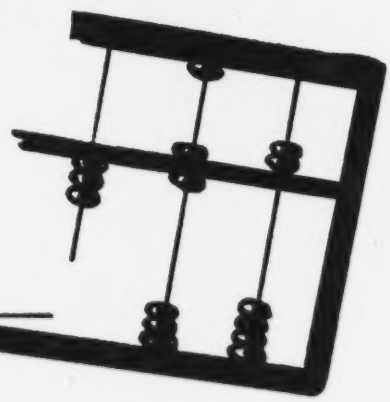
- - - - - - - - - - - - - - -

I KNOW THE PARTS OF A COMPUTER SYSTEM

.....MEMORY.....INPUT.....OUTPUT.....
....CONTROL UNIT.....ARITHMETIC UNIT....

DATE: _____ AWARDED TO: _____

I DONT GUESS WITH MY ABACUS



awarded to: _____

date: _____

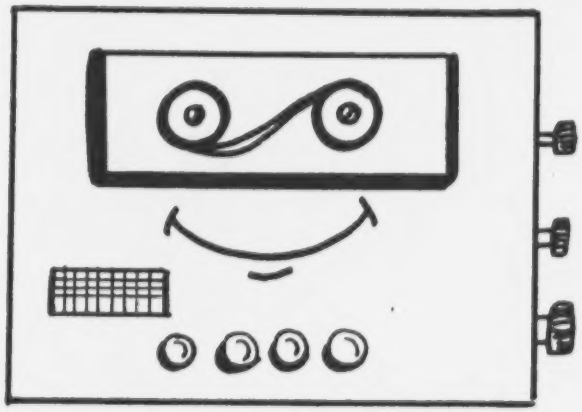
is a Breeze!

awarded to: _____

date: _____

I'VE LEARNED THE COMPUTER LANGUAGE "BASIC"

~ and have successfully written a program.



to: _____

date: _____

Answer Key

Base Two Work Sheet (p.7)

A.	1.c 2.b 3.b	B.	1.a 2.c 3.a	C.	1. 1000	2. 10100	3. 100010	
D.	1. 111		2. 111		3. 10	E. 1. 1111	2. 1011011	3. 1001011

Possible Answers for Student Workbook

More Challenge (p. 29 & 30)

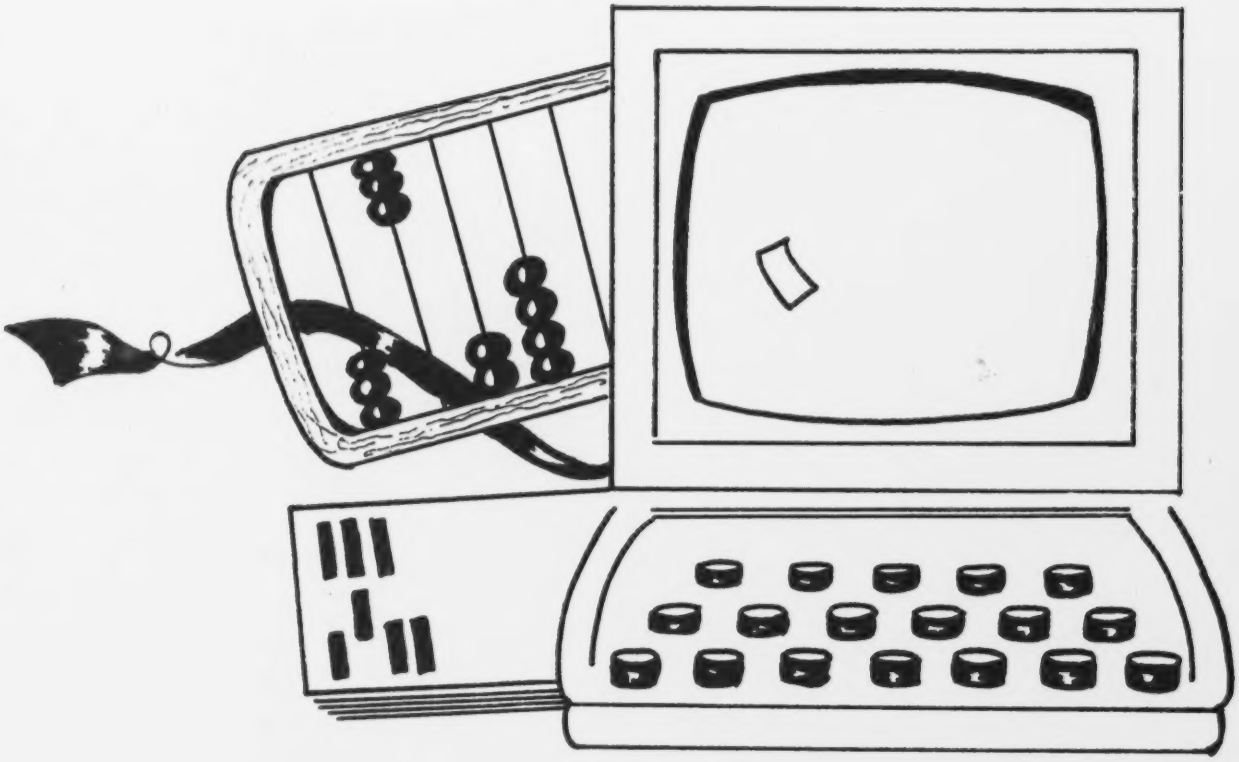
1.
```
100 READ W,S,T
110 LET F = (W+S)*T
120 PRINT "F ="; F
130 GO TO 100
140 END
150 DATA 3,2,5,40,25,6
```

2.
```
100 READ L,W
110 LET A = L*W
120 PRINT "A ="; A
130 GO TO 100
140 END
150 DATA 5,3,10,2. 6,12,3, 2
```

3.
```
100 X = 0
110 X = X+2
120 PRINT X
130 IF X<100 THEN 110
140 END
```

4. All of these would have a similar form to problem 2.

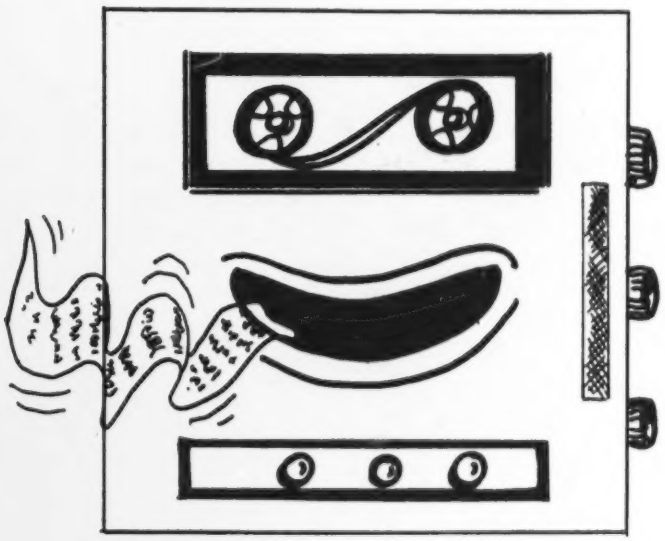
THE COMPUTER REVOLUTION



This booklet belongs to _____

COMPUTERS--WHAT ARE THEY?

Many people are afraid of computers and think of them as superpowered brains that will ultimately take over the world.

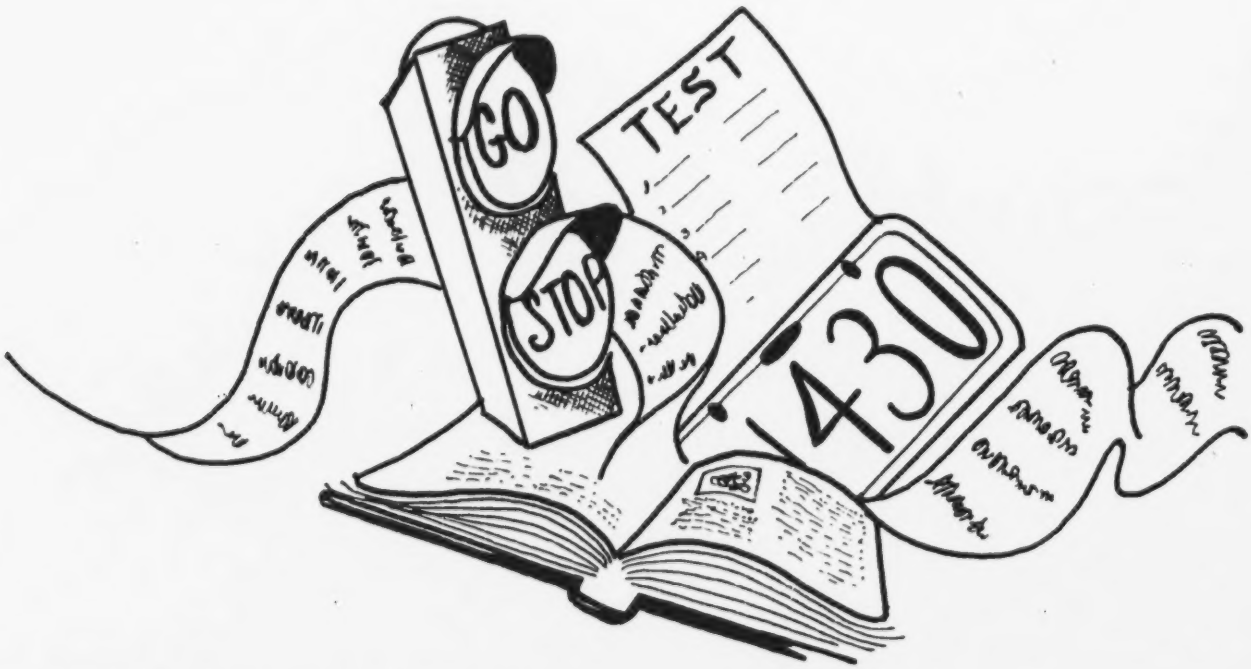


The fact of the matter is a computer is totally dependent upon man and is incapable of doing anything unless instructed by a human. A computer can do arithmetic calculations at a tremendous rate, far exceeding capabilities of a human both in accuracy and speed. Many problems solved within hours by a computer would take a mathematician a lifetime to complete. However, a computer must be programmed or told what to do and how to do it, so man is still the creative and essential force. A computer follows the directions supplied to it by a human and automatically performs complicated and often tedious mathematical operations to arrive at an answer.

Here is a list of some of the things computers are used to doing in today's busy world.

control the flight of rockets and missiles
solve physics and engineering problems
design other computers
automatically operate machine tools
predict the weather
run entire factories automatically
predict and simulate the performance of an airplane, missile, car or whatever before it is built
solve complicated mathematical equations
make out bills
make out paychecks
do inventories
typesetting--newspapers/magazines--articles typed in and then edited and printed by computer
reservations--airlines, railroad, and some motels

mailing lists--Many form letters are typed by computers with a personal touch. The computer puts a person's name in key positions to make it appear that each letter has been specifically dictated and typed for the individual.
traffic lights
tests at school
banking--A code printed on checks in magnetic ink characters.
police--Fingerprints,stolen cars, criminal records, license plate numbers are all kept on computers.
library--Cards and books all have been coded to be read by light pen and laser beam.
telephone companies--switching--Also you hear from a computer when a telephone number has been changed.



The list goes on and on and every day new uses are being developed. Everyone has contact with computers every day. At stores, products are coded to be read by computers so an accurate track of sales and inventory can be kept. The telephone can be thought of as a giant computer network, and when we hear telephone number corrections or changes, we are listening to a computer. Most paychecks are prepared by computers as are most bills. One of the most famous cases of "computer frustration" occurred when a man received a bill for $0.00. The man sent a letter to the company but received a reminder note a few weeks later stating he must have overlooked the bill for $0.00. The computer continued to send notes of reminder and eventually threatened to discontinue use of the man's charge card unless the charge of $0.00 was

taken care of. The man's solution was simple but effective. He wrote a check for $0.00 and sent it off in the mail. A few days later, he received a thank-you from the computer. Obviously an error had been made in programming the computer.

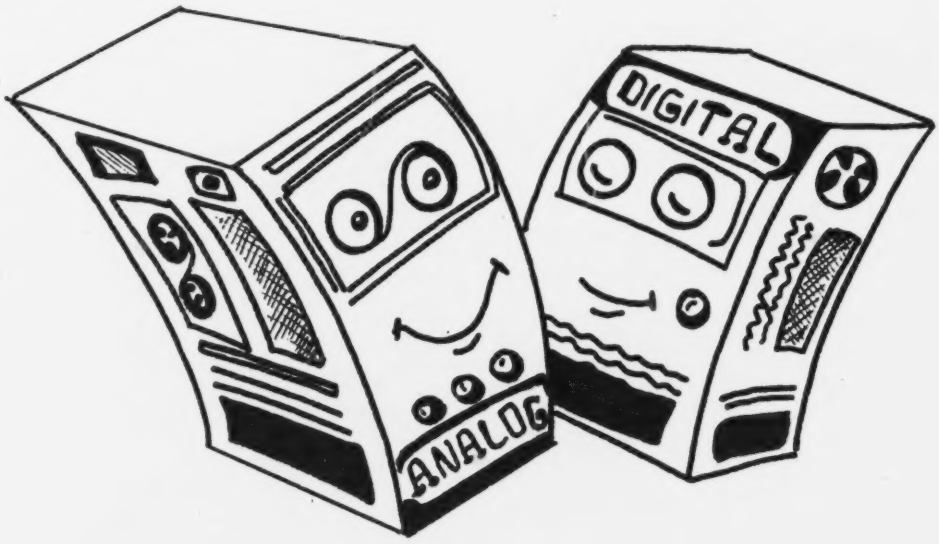
This brings up an important point--computers don't have opinions or judgements. In fact, they will carry out the performance of a program without questioning truthfulness or validity.

Computers come in many sizes and shapes. The very first digital computer ENIAC filled a room and weighed thirty tons. Microcomputers of today fit on a coffee table and can easily be carried around.

There are two types of computers based on the way in which they operate. These are either the analog or digital computers.

Analog computers compare things. These are usually special-purpose computers that can measure things like rate, heat, fluids, and so on.

The digital computer is a general-purpose machine and is used much more than an analog computer. The digital computer works with numbers and arithmetic operations which include adding, subtracting, multiplication, division, percent, comparing (greater than, equal).

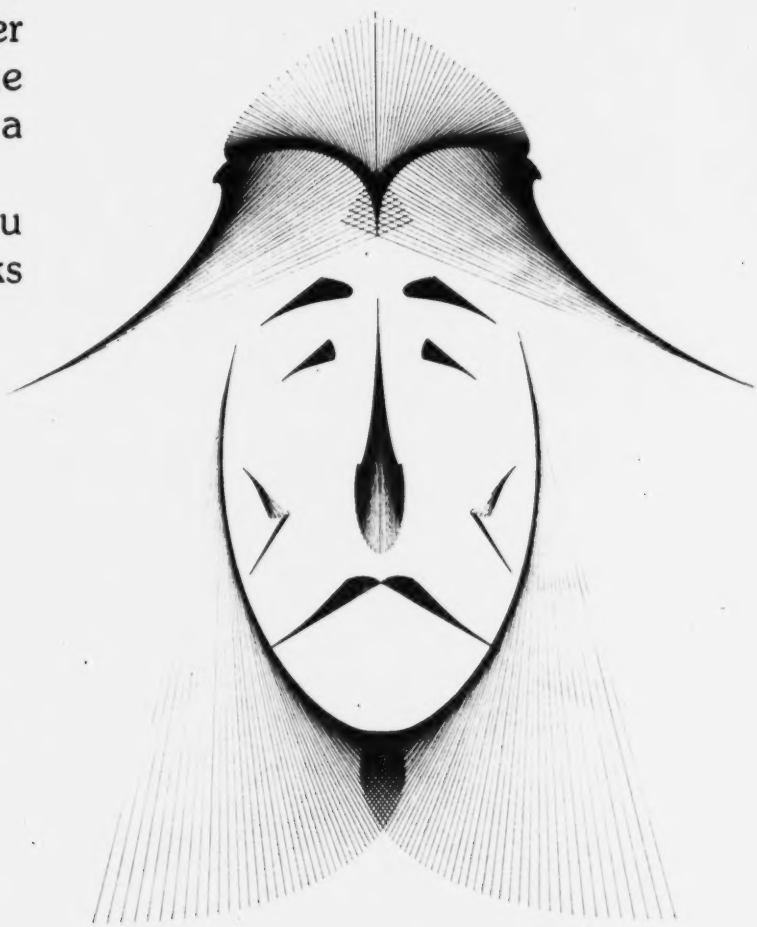


COMPUTER ART

Computers have been introduced into the arts with much success. Graphics, films, advertising, music, sculpture, dance and mixed media are all areas where computers have had an influence. It appears that in many cases the brush has been replaced by the light pen, and artists and programmers are working hand in hand. Many commercials on TV of psychedelic quality are created through the use of computer art.

This picture was created by a computer when the machine was asked to draw a picture of a human.

Why do you think the picture looks as it does?



"THE FISHERMAN" by CalComp

.....COMPUTER CHALLENGE.....

Use the front and back of this page to keep a record of articles or cartoons you find about computers. Also, see if you can find other examples of how computers are being used.

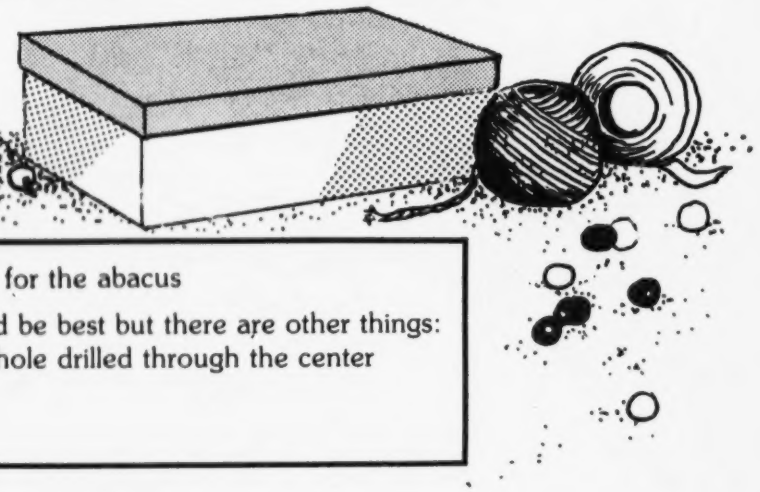
Here's a cartoon to get you started!

"I have to see the nurse! Which button is it?"

Directions for Construction of a Homemade Abacus

The abacus requires seven markers per place value--two above the bar and five below.

Materials: shoe box
twine
tape

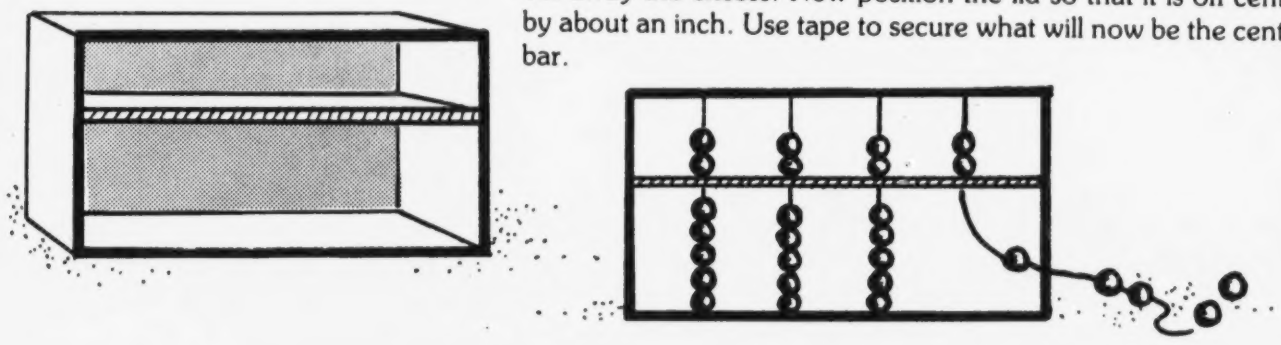


something for the abacus

markers--beads with a hole would be best but there are other things:
- ✔ caps from bottled pop with a hole drilled through the center
- ✔ paper clips
- ✔ buttons

Procedures:

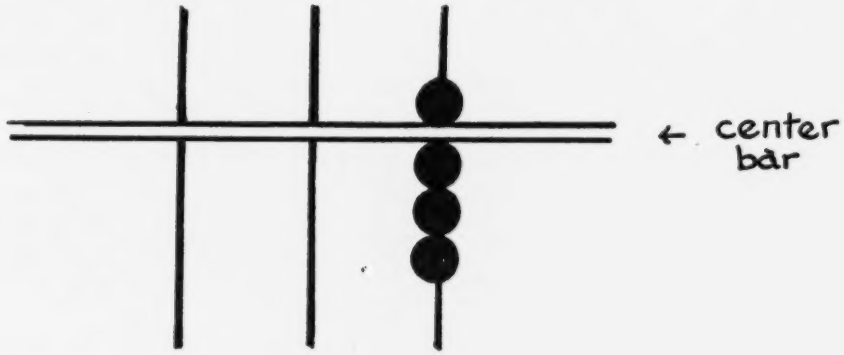
1. Use the shoe box lid for the center bar. Squeeze the lid into the box so that it is perpendicular to the box bottom and parallel to the box sides. Mark where the lid comes above the box sides and cut away the excess. Now position the lid so that it is off center by about an inch. Use tape to secure what will now be the center bar.



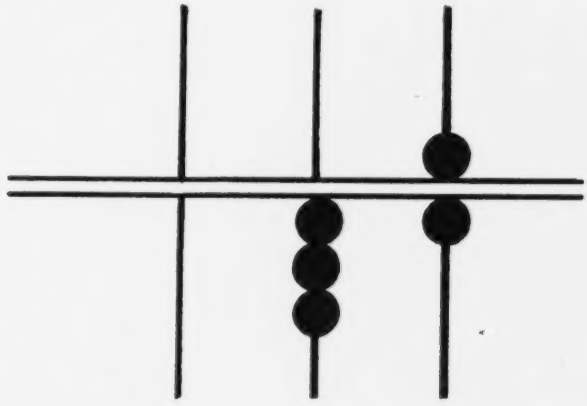
2. It is now time to decide how many place values you will have. This will be determined by the number of markers you have. Remember seven markers per place value. Every abacus has to work at least into the 1000's place so let's have four place values. Mark across the long side of the box four equal spots. Punch a hole at each of these places and also at corresponding points on the center bar and the other side of the box. Twine will be used to hold the markers. Pass twine through the top right-hand hole. Slide two markers onto the twine and then pass it through the center hole. Slide five markers on and pass the twine through the final hole for this place value. Use tape to secure the twine on both sides after pulling the twine taut. Repeat this procedure for all additional place values.

COMPUTERS--THE BEGINNING

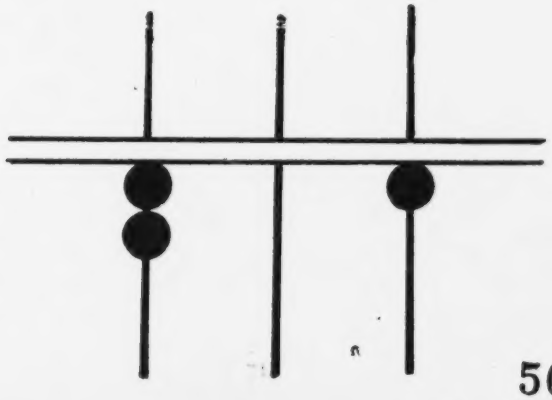
The abacus, developed in China, Japan, Egypt, or Greece (no one knows for sure) about 3,000 years ago, was the first computing tool and is still in use today. The beads represent numbers when they are placed at the center bar. Notice that there are five beads on each wire below the center bar and two beads above. The beads below each represent a value of one and the beads above the bar have a value of five each. The wires that the beads are on represent place values of 10. To represent the number 8, we shift the beads as follows:



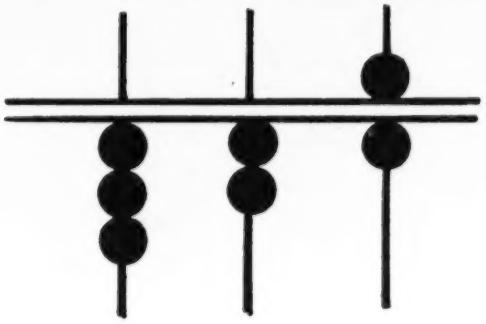
To show 36, we would move the beads to these positions:



For number 201, we show:

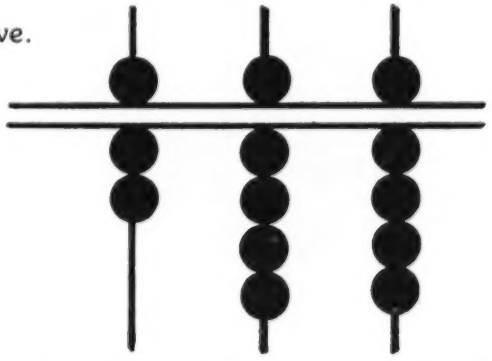


To add on the abacus, we first register one number into the device. Here we will register 326.



To add 473, we just slide more beads. In the 1's place, we slide up three more beads. In the 10's place, we slide down one 5 bead and slide up two 1 value beads. In the 100's place, adding a 5 bead and sliding down a 1 bead is the same as adding 4.

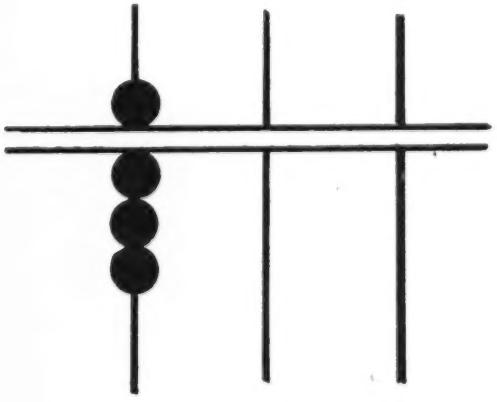
So here is what we have.



799

Any time a wire or string of beads equals 10, we move all the beads on that wire away from the center bar and add a 1 bead in the next place to the left.

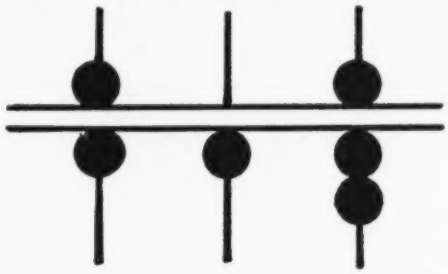
Adding 1 to the abacus above would increase the number of beads in the 1's column to 10. We would move all beads in that column away from the center bar and add one bead to the 10's column. This, in turn, causes the number of beads in that column to reach 10 so we also clear that wire and add a bead to the 100's column.



800

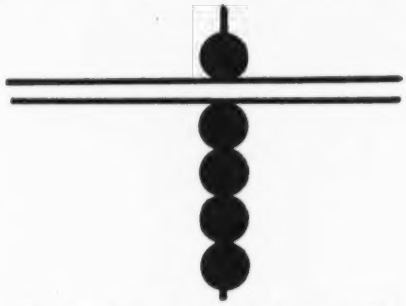
Subtraction on the abacus

Place the larger of the two numbers in the abacus first. Let's subtract 425 from 617. This means 617 would be recorded in the abacus.



617

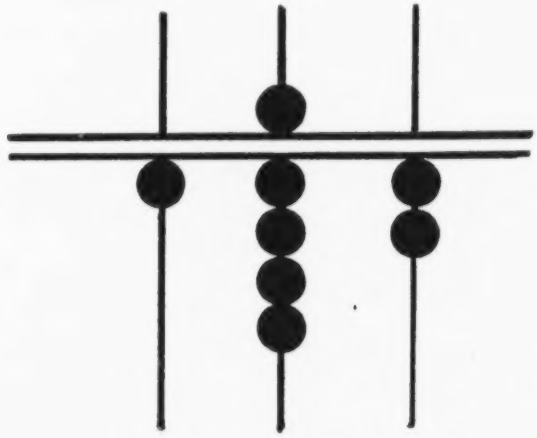
To subtract 425, we start in the 1's column and simply remove or slide the 5 bead away from the center bar leaving two 1 beads. Now, in the 10's column, we see we can not subtract two beads with only one bead present. So we borrow from the 100's column. The 1 bead in the 100's column is slipped away and two 5 beads in the 10's column are brought to the bar. Now, to subtract 2 we remove one 5 bead and add three 1 beads, leaving this in the 10's column:



Removing a 5 bead and adding three 1 beads is the same as subtracting 2.

Now, for the hundred's column. We have borrowed so on that wire all that remains is a 5 bead. To subtract 4 from this, we remove the 5 bead and bring up one 1 bead.

Here is the result.



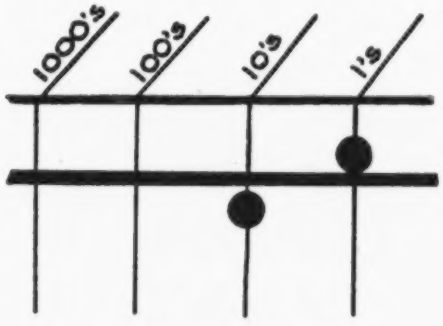
192

Multiplication is a little more involved. Let's say we wish to multiply 45 by 23.

First put the two numbers in the left side of the abacus for reference. Now, multiply the 3 × 5 and register it in the right side of the abacus with a 5 bead in the 1's place and a 1's bead in the 10's. Now, multiply 3 × 4 to get 12. However, the 4 is in the 10's place, so shift the answer over so that the 2 is recorded in the 10's place of the abacus and the 1 is in the 100's place. Next, multiply the 2 × 5 to get 10, and add beads in the following fashion. No beads to the 10's place but one bead to 100's place. Lastly, 2 × 4 gives us 8, but this will be added to the 100's place. Because the 100's place already has two beads, the eight more would make ten so no beads will be in the 100's place and one bead will go in the 1000's place.

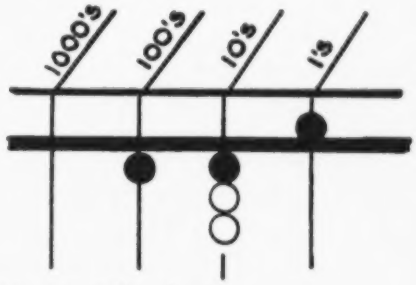
First Step

5
×3
15



Second Step

4
×3
12

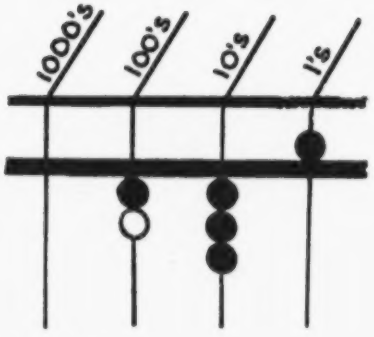


(4 is in 10's place)

(12 answer to 10's place)

Third Step

5
×2
10

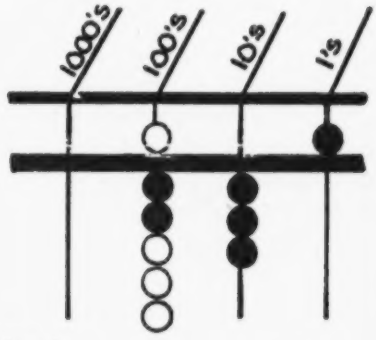


(2 is in 10's place)

(answer to 10's place)

Fourth Step

4
×2
8

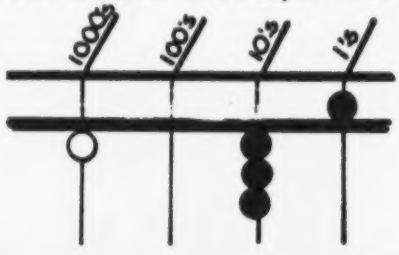


(both in 10's place)

(answer to 100's)

Fifth Step

Ten beads in 100's equals 1000.

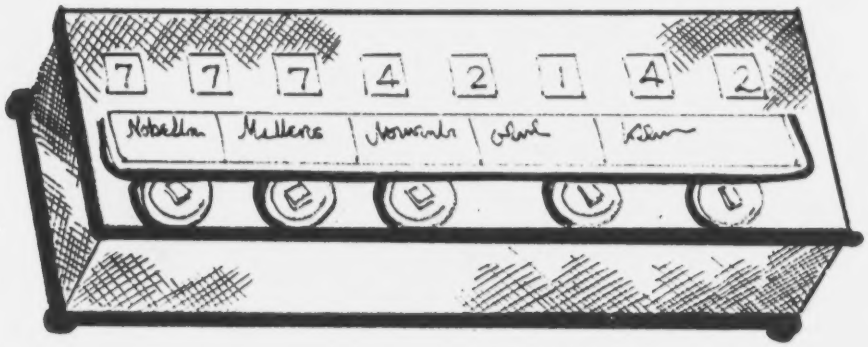


1,035 answer

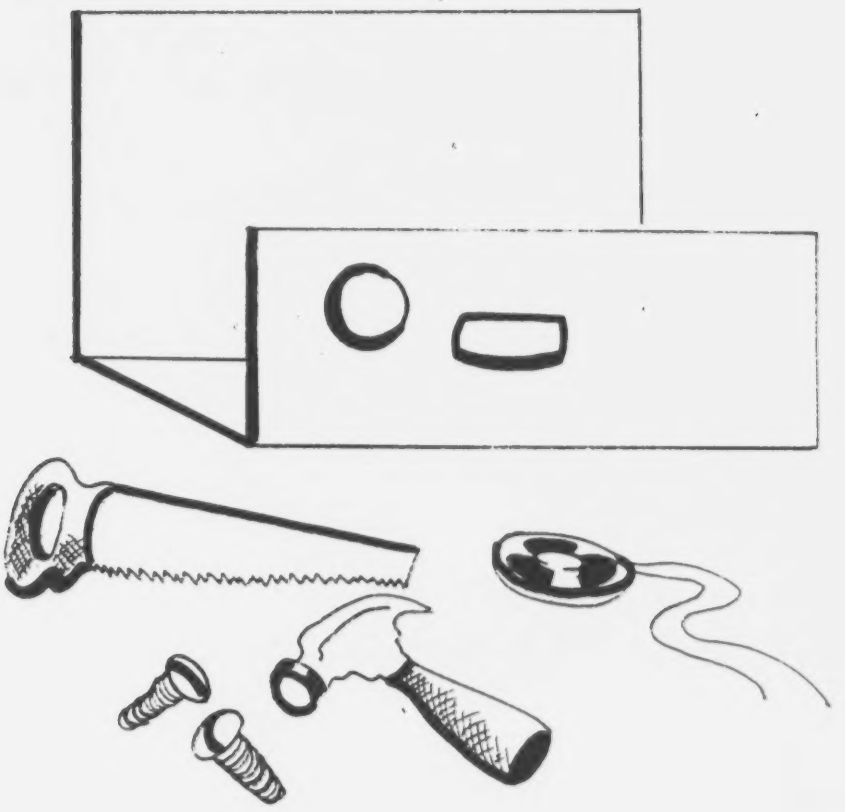
In 1804 Joseph Jacquard devised a method for controlling a weaving machine. He came up with a method of signaling a fabric design through the use of cards with holes. This was the beginning of the punched card system that is still used to input information into many computers of today.

In 1642 Blaise Pascal, at the age of nineteen, invented a small machine for doing addition problems. It contained eight wheels each with the numbers zero through nine written on them. When one wheel made a complete circle it automatically advanced the wheel to the left one number. Totals appear in the little windows above the dials.

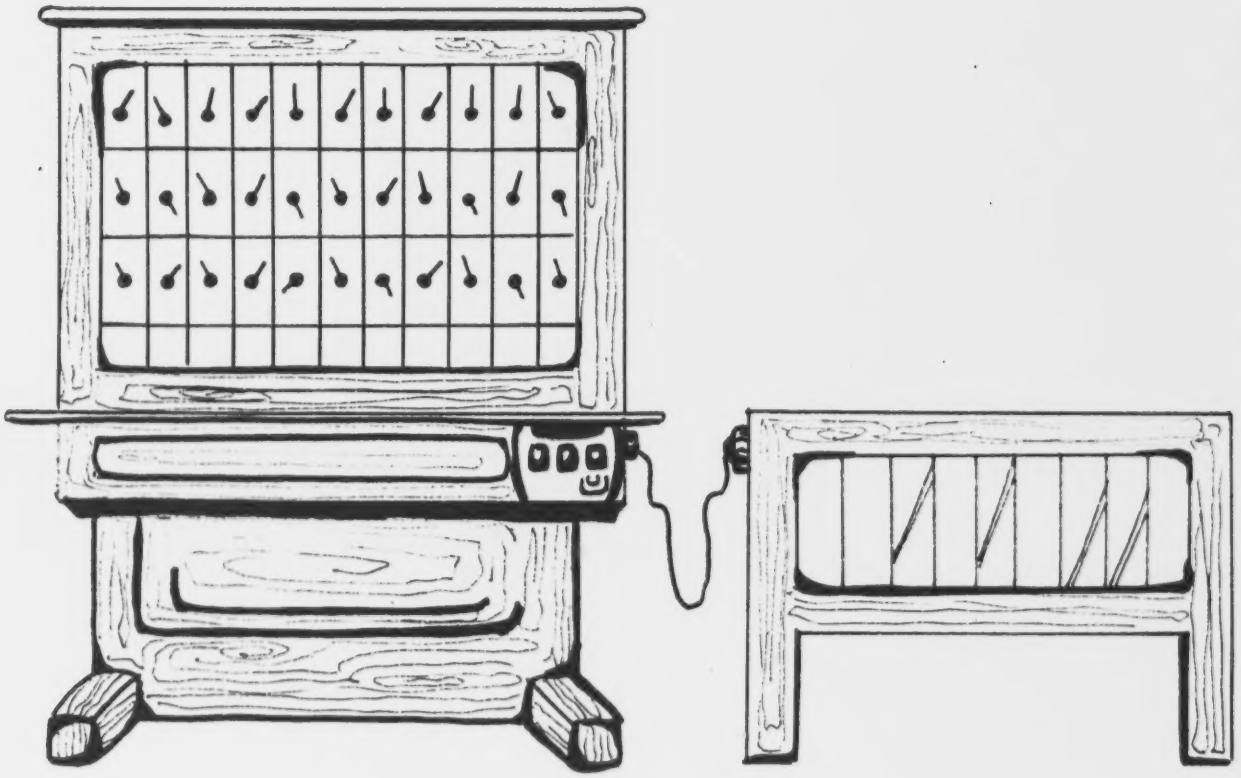
Gottfried Wilhelm Leibnitz, a German mathematician, used this idea to develop machines that could multiply and divide. This was done in 1671.



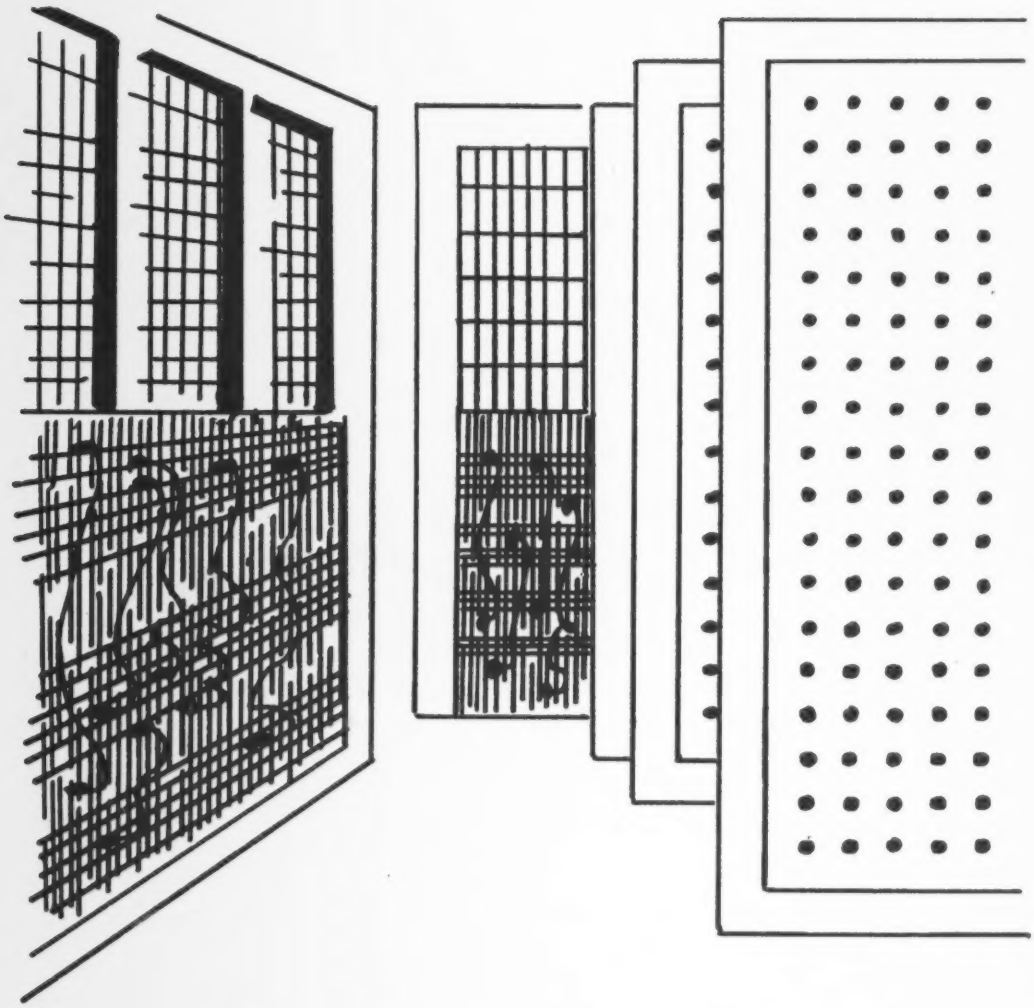
An Englishman, Charles Babbage, was influenced by Jacquard's loom machine and drew up plans for a machine that could do them quickly. Unfortunately, his machine was never finished, because the tradesman of the 1830's couldn't make the thousands of parts required.



Herman Hollerith, an American, worked for the Bureau of the Census. In 1880 the census took seven and a half years to be tabulated and sorted. Hollerith invented a tabulating machine that used the principle of the punched cards. As a result, it only took two years to collect and sort the 1890 census. Holes were punched into cards to represent different bits of information. Then the cards were sent through a machine that allowed pins to strike the card. When a pin came to a hole, the pin would go through and touch a wire forming an electric circuit that would register the answer on the dial.



The next real breakthrough was not until 1946 when the first fully electronic computer was built. It was developed by two Americans, J. Presper Eckert and John W. Mauchly, and it weighed more than 30 tons. They called it ENIAC (Electronic Numerical Integrator and Calculator). It could do 5,000 additions in one second.



COMPUTER GENERATIONS

The first generation of computers came out in 1950. Thousands of calculations could be performed in one second. Vacuum tubes were used making these computers very large and bulky.

In 1960 the second generation computers were designed. These computers were ten times faster than first generation ones. Transistors were used instead of vacuum tubes making second generation computers faster and smaller.

The year 1965 marks the introduction of the third generation of computers. These computers can do one million calculations a second because of tiny integrated circuits.

Fourth generation computers are even faster, smaller, and more dependable. They rely on *microminiaturization* and the use of *chips*. The integrated circuits were miniaturized and placed on very, very tiny chips. Many millions of calculations per second can be done with these computers.

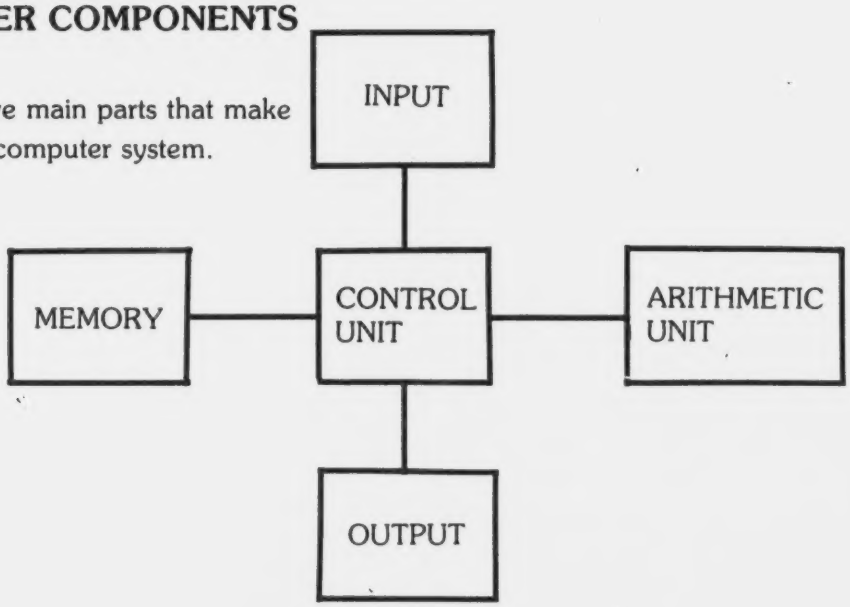
WHAT WILL THE FUTURE HOLD?

In just thirty short years, computers have gone from machines that filled rooms to microcomputers that can be carried around in a briefcase. Every day, more and more uses are found for computers.

Let your imagination help you think of the world of the future. What will it be like thirty or forty years from now when computers have even more of a role and influence in our lives?

COMPUTER COMPONENTS

There are five main parts that make up a digital computer system.



I. INPUT We must have a way of communicating with the computer to enter a program and data. There are a variety of ways to do this.

A. Typewriter--terminal or keyboard gives access to the computer.

B. Card Reader--reads punched cards by detecting holes in them when light passes through those holes. The holes are made on a key-punch machine that operates like a typewriter but punches holes that stand for letters and numbers.

C. Optical Reader--uses cards like the card reader but instead of holes punched into the cards, pencil marks are made. The graphite left by the pencil mark is read by the machine when light bounces off it.

D. Paper Tape--this is similar to the punched card reader as information is in the form of punched holes. However instead of cards, the paper tape is a narrow roll of tape of any length.

E. Magnetic Tape--this tape can be magnetized and 1,000 letters and numbers will only need one inch of tape. Tape units are machines that put the information onto the tape or send it to the computer's memory.

F. Magnetic Disks--these resemble large phonograph records and information can be retrieved very quickly from them.

II. MEMORY UNIT Information is stored here until it is needed. The bits of information are stored by address on magnetic cores. The cores are in the shape of a doughnut and can be magnetized in one direction to register a "0" and in the other direction to represent a "1." These cores are very tiny, so ten cores could fit on the top of a pinhead.

If there is a great deal of information to be stored outside of the computer's memory, then magnetic tapes, disks, and punched cards are used (bulk storage).

III. CONTROL UNIT This part of the computer is responsible for directing the proper execution of a program. The control unit selects what must be taken from memory and what should go on to the arithmetic unit. It also directs what information should be sent to the output equipment.

IV. ARITHMETIC UNIT This is the part of the system where all calculations and arithmetic operations take place.

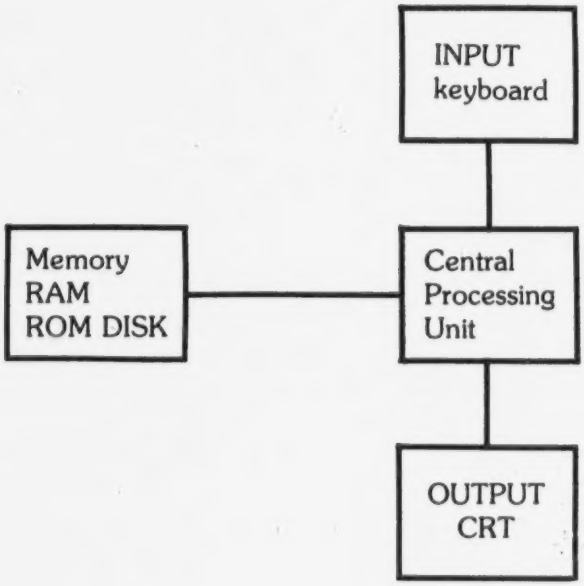
V. OUTPUT EQUIPMENT After the arithmetic unit has completed its job, the results are stored in the memory. When the program gives the command "PRINT," the control unit responds by retrieving the answer from the memory and sending it to the output equipment. The output equipment is designed to provide the results and answers in a form we can read and understand. Some forms of output are the high speed printer, automatic typewriters, or CRT (Cathode Ray Tube).

A. The high speed printer can print 1200 lines per minute. This machine is so fast that it is impossible to read what is being typed while the machine is operating.

B. The automatic typewriter is slower but like the printer gives a typed record.

C. The CRT is an electronic vacuum tube like a television screen which will display printed words and numbers. In addition, graphics can be created and displayed. If a printer is hooked up to the CRT, then displays can be saved on paper in addition to being seen on the screen.

Punched cards, magnetic tape, disks, and paper tape are also used for storing information from the output section. This is handy because this information can be fed back into the computer when needed.



MICROCOMPUTER COMPONENTS

The microcomputer receives input through the keyboard.

The C.P.U. (Central Processing Unit) is the nerve center of the microcomputer. It is made up of the microprocessor chip that has thousands of electronic circuits on it.
It interprets the program, directs information and tells the computer how to carry out the instruction.

The microprocessor chip is this size.

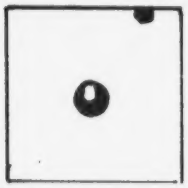
The Memory is of two kinds, ROM and RAM. ROM stands for "READ ONLY MEMORY" and is permanent memory that contains the language (BASIC) that is used to communicate with the machine. RAM stands for "RANDOM ACCESS MEMORY" which is where a program from a disk or tape is stored temporarily.

The Disk is a form of auxiliary memory--a place to store programs. The floppy disk resembles a small phonograph record. It is magnetic and can retrieve programs very quickly.

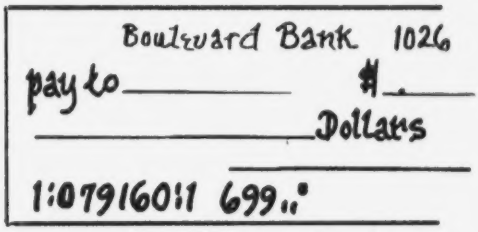
Output on the microcomputer is displayed on a TV screen (CRT). A printer may also be connected to have a record of what is on the CRT transferred to paper.

MEANS OF INPUT OR STORAGE

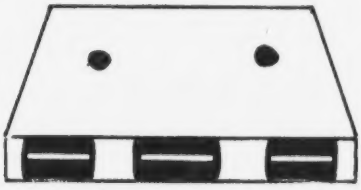
disk



floppy disk

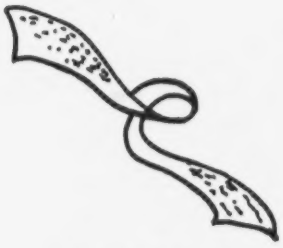


magnetic ink characters



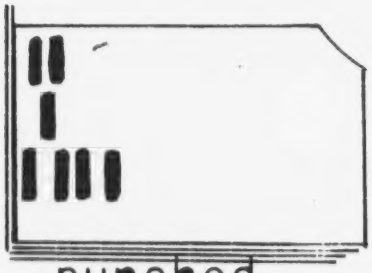
cassette tape

magnetic tape

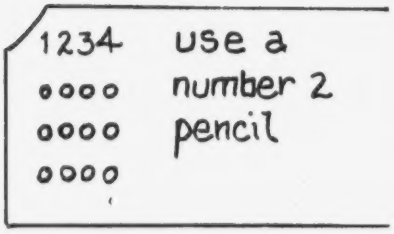


paper tape

universal product code

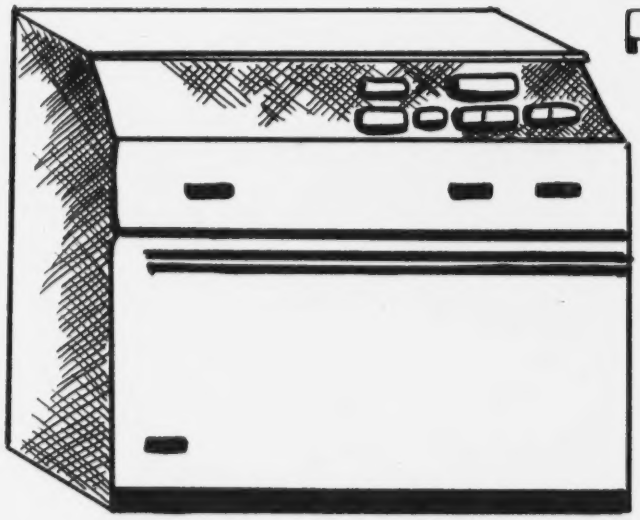


punched cards

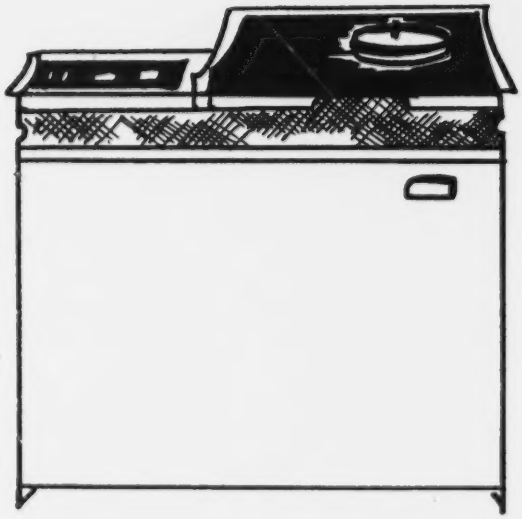


mark sense

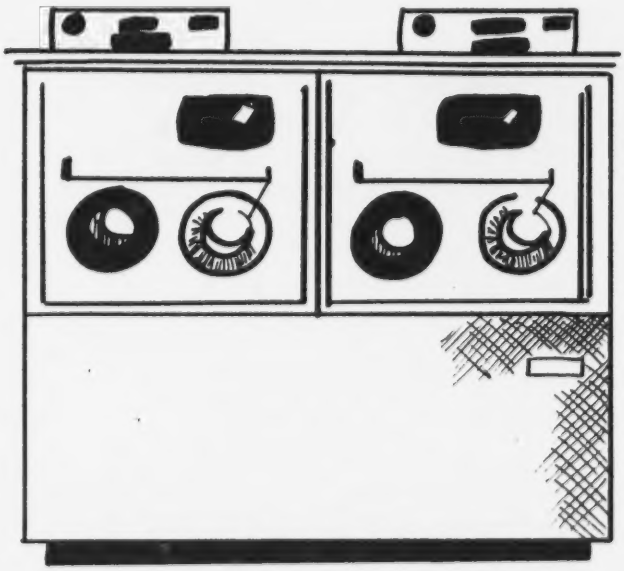
INPUT EQUIPMENT



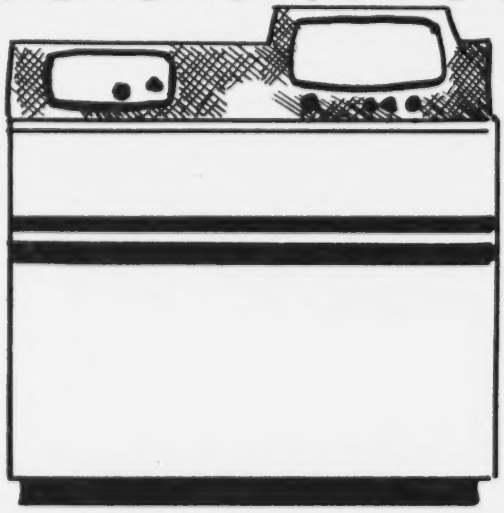
PAPER TAPE READER



MAGNETIC DISC UNIT



MAGNETIC TAPE UNIT

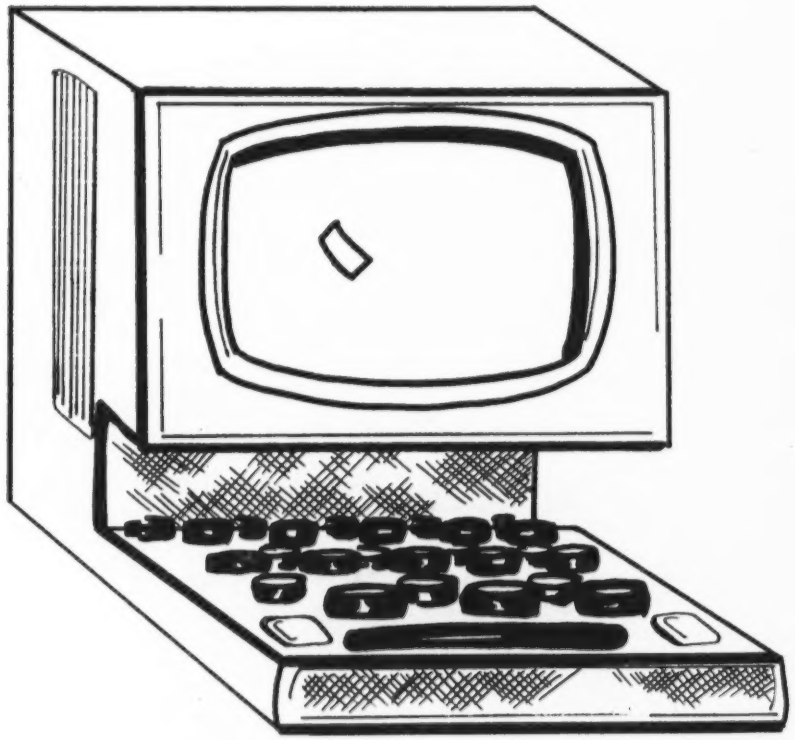


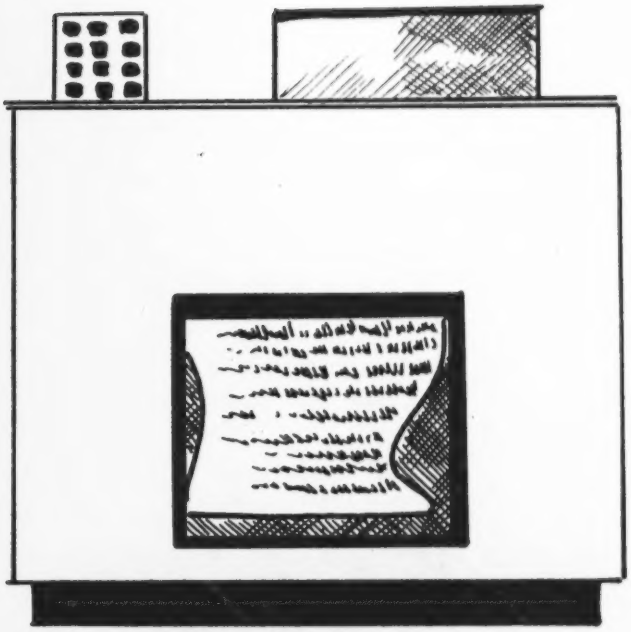
CARD READER

OUTPUT EQUIPMENT

CRT

CATHODE RAY TUBE





HIGH SPEED PRINTER

FLOW CHARTS

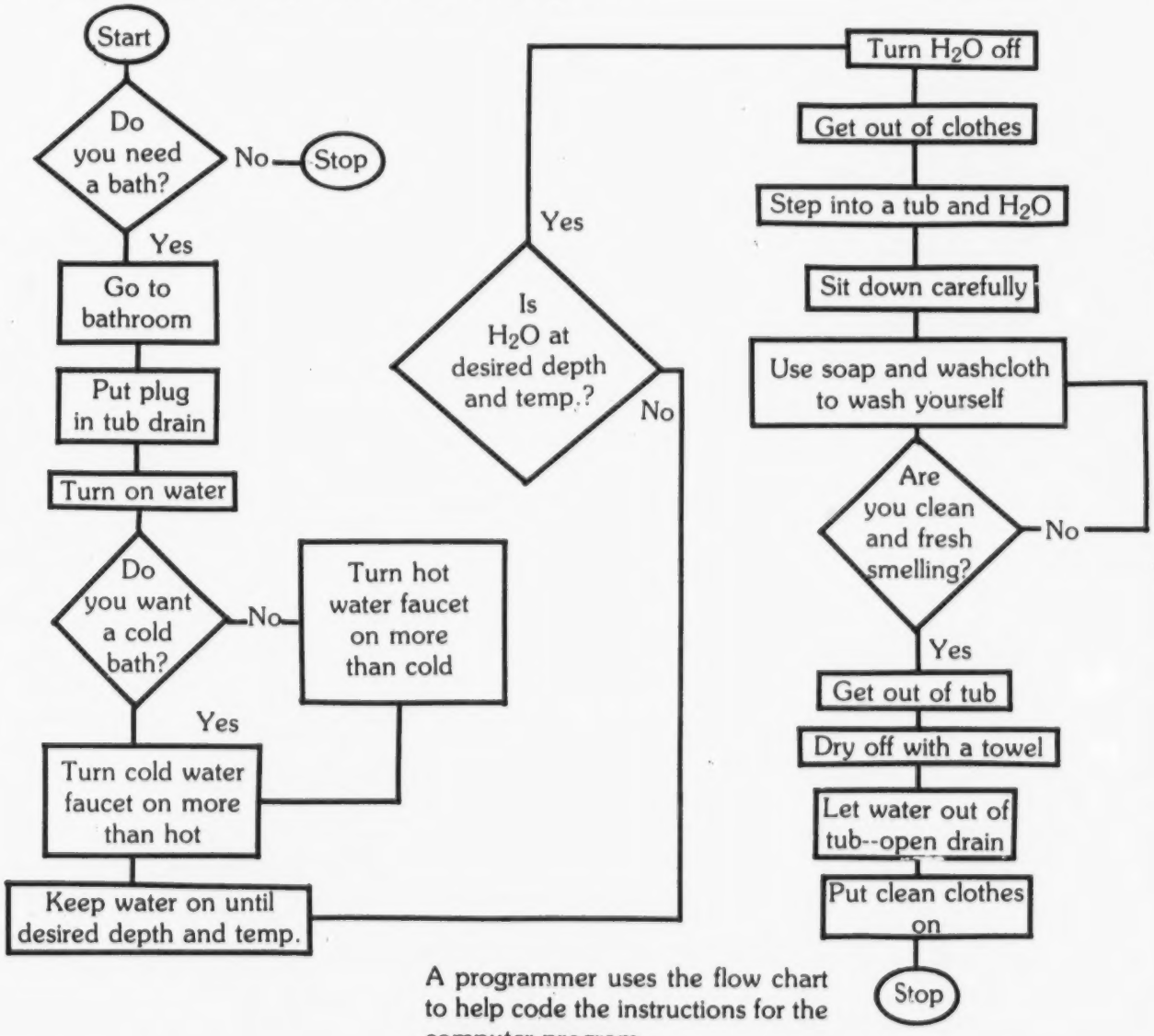
Flow charts are used by computer programmers to plan the different steps and procedures of a specific program. Before writing a program, a flow chart is prepared to examine how different parts of a program might relate to one another. There are three main symbols used in flow charting.

The symbol is used at the beginning or end to signify start or stop.

This one is an instruction box.

The third symbol is a decision box and looks like this .

Let's put together a simple flow chart for taking a bath.



A programmer uses the flow chart to help code the instructions for the computer program.

FLOW CHART

Start

Put pencil on square marked A

move left one square

Is there a number in square ?

NO

yes

is number a zero ?

yes

NO

subtract one from number and write in new number

move left 3 squares

add 1 to number in square and write in new number

move right 3 squares

move left one square

Is the number a zero ?

yes

no

subtract one from number and write new number

move left 3 squares

add one to number in square and write in new number

move right 3 squares

CONGRATULATIONS ~ you are finished!

Put down pencil!

STOP

			5	1		4	2		A

FLOW CHART CHALLENGE!

Design a flow chart for making a phone call.

COMPUTER PROGRAMMING IN ~ "BASIC"

Each line must have a number and a "Basic" message or statement.

READ is used to identify variables and to tell the computer to assign data numbers or values to those variables. The "data" will be supplied at the very end of the program.

INPUT is a statement that also identifies and assigns values to variables. However, in this case, the data will be typed in when the computer is ready for it. A question mark (?) will appear which indicates the computer is ready for the INPUT data.

DATA is used to enter values into the program.

Let X = A*B identifies the equation. This is an equation for multiplying two numbers.

PRINT is a means to receive answers and information from the program. Anything within quotation marks after a PRINT statement will be printed out.

GO TO sends the computer into a loop to repeat certain parts of a program.

IF--THEN also may send the computer into a loop but only after making a comparison such as:

IF A < 5 THEN 10.

This means if the value for A is less than 5, then go back to line number 10 and repeat part of the program. If the value of A is not less than 5, then the computer will go on to the next line.

END stops the program. It must have the largest line number with the exception of the DATA and must appear in every program.

RUN is the command to start a program. If the computer accepts a program without indicating any errors, then typing in RUN will signal the computer to do the program.

* multiplication
/ division
+ addition
- subtraction
" exponents
( ) used to indicate in an equation those operations to be done first, such as:

A = (2*3) - (16/4)
A = 6 - 4
A = 2

Here is a program for adding two numbers.

```
10 Print "ADDITION OF TWO NUMBERS"
20 READ Y,Z
30 LET W=Y+Z
40 PRINT W
50 END
60 DATA 3,10
```

This is what the computer would type back:

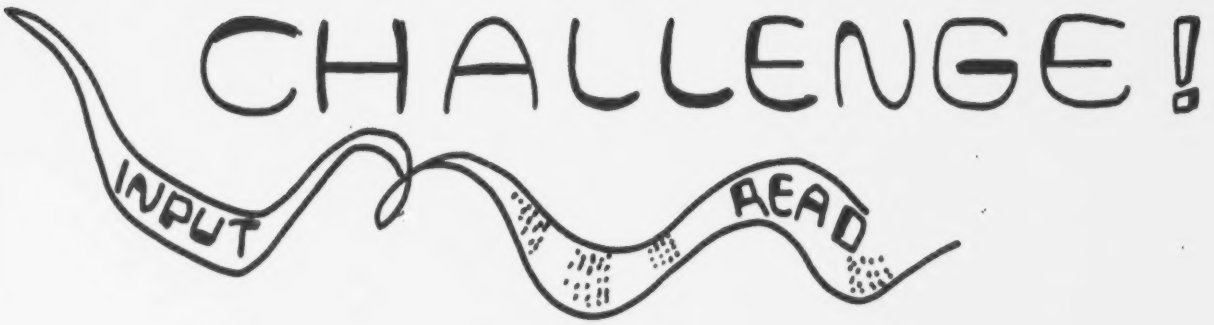
```
ADDITION OF TWO NUMBERS
13
```

Let's say we want to solve a whole page of addition problems, not just one. We can change this program slightly to allow more data and an automatic repeat of the program. We will add a new line between the PRINT statement and the END. It will be 45 GO TO 20. This automatically sends the computer back to line 20 which is READ Y,Z. The computer reads the next two values for Y and Z from the DATA and then proceeds through the program again, step by step.

```
10 PRINT "ADDITION OF TWO NUMBERS"
20 READ Y,Z
30 LET W = Y + Z
40 PRINT W
45 GO TO 20
50 END
60 DATA 3,10,9,65,1000,12000
```

Now for a print out, we would get:

```
 ADDITION OF TWO NUMBERS
 13
 74
 13000
```



Put your thinking cap on and rewrite this program to use an INPUT statement instead of the READ statement.

DO IT RIGHT HERE

71

MORE CHALLENGE!

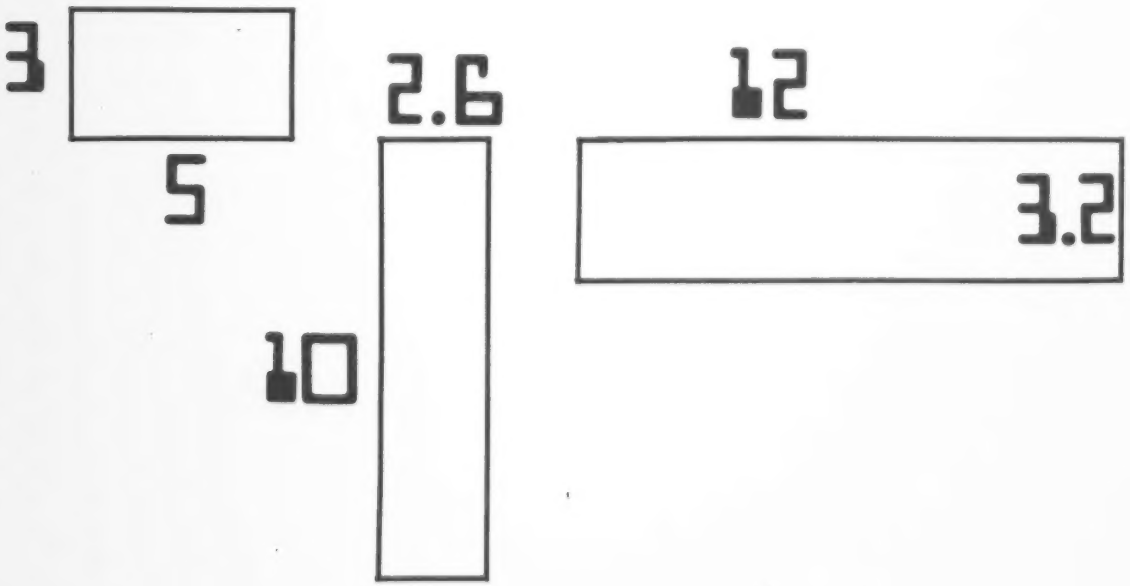
ORDER! ORDER!

1. See if you can put this mixed-up program in the proper order. Once you have done it in the correct order, assign line numbers.

```
PRINT "F =";F
END
READ W,S,T
DATA 3,2,5,40,25,6
GO TO 100
LET F = (W+S)*T
```

2. Write a program that will calculate the area of three different rectangles. The formula for a rectangle is A = L × W (Area equals Length times Width).

   Here are the three rectangles.



3. Write a program that counts by two to one hundred.

4. Use one of these formulae and write a program using an INPUT statement.

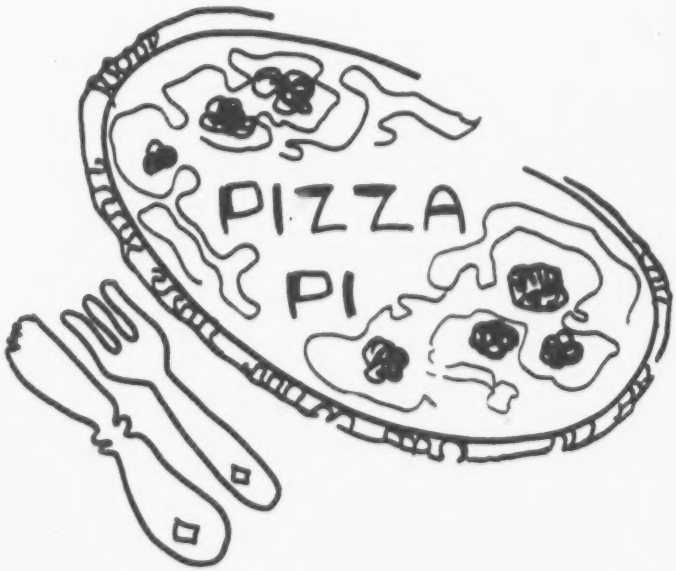
a) Volume of rectangle $V = L \times W \times H$
(Volume equals Length times Width times Height)

b) Circumference of circle $C = \pi \times (2 \times R)$
(Circumference equals Pi times two times Radius of circle)

c) Area of circle $A = \pi \times R^2$
(Area equals Pi times Radius squared)

d) Volume of circular cylinder $V = (\pi \times R^2) \times H$
(Volume equals Pi times Radius squared times Height)

Note: this π stands for 3.14 or Pi.
When writing your program, use 3.14 for π.



THE GROWING FAMILY OF GOOD APPLE PRODUCTS INCLUDES:

☆ ***PERIODICALS*** . . . four to choose from . . . each will bring you a wealth of ideas.

★ **THE GOOD APPLE NEWSPAPER** . . . Ideas! Ideas! Ideas! That is what *The Good Apple Newspaper* is all about. Each issue, and there are five each school year, is a treasure-house of materials for the K-8 teacher. Games, posters, units of learning, task cards, bulletin board ideas, etc. Ideal for all subject areas, adaptable for all grade levels . . . innovative, skill-building, easy-to-use ideas for you and your students.

★ **LOLLIPOPS, LADYBUGS AND LUCKY STARS** . . . And you will thank your lucky stars for finding this newspaper of ideas and activities for teachers of preschool and primary children. Each year there are five 32-page issues chocked full of delightful learning experiences for early learners: patterns, poems, stories, readiness skills, reinforcement activities for all subject areas, arts and crafts, reading, music!

★ **CHALLENGE** . . . **reaching & teaching the GIFTED child**: . . for parents and teachers of gifted, talented and creative children of all ages. Our **CHALLENGE** at Good Apple is to put the world of gifted education at your fingertips-- identification, evaluation, methods of instruction, materials, model programs, units of study, mind benders--with the nation's prominent authorities in the field helping. Joe Wayman, editor.

RAINBOWS, DREAMS AND BUTTERFLY WINGS. . . an exciting religious education publication. Thirty-two cleverly illustrated pages of practical teaching techniques and suggestions for educators teaching in private schools, church programs and parents seeking materials for home use, including Bible quiz activities, creative writing, family worship, bulletin board ideas, posters, music-related fun, Biblical heroes, gameboards, arts, crafts. (K-8)

☆ ***BOOKS***. . . over 150 titles in all subject areas for all grade levels, preschool - 8. Idea books, activity books, bulletin board books, units of instruction all with many reproducible pages.

READING	READINESS	VOCABULARY	SPELLING
BOOK REPORTS	DICTIONARY FUN	LANGUAGE ARTS	CREATIVE WRITING
CREATIVITY	GIFTED EDUCATION	BASIC SKILLS	STORYTELLING
GAMEBOARD IDEAS	POETRY	MATH (all areas)	METRICS
LEARNING CENTERS	CONTRACTS	OUTDOOR EDUCATION	INDEPENDENT STUDY
SCIENCE	SOCIAL STUDIES	SELF-CONCEPT	MEDIA-TELEVISION
ARTS/CRAFTS	PRESCHOOL	PRIMARY	MIDDLE SCHOOL
HOLIDAY IDEAS	BULLETIN BOARDS	TEACHER HELPERS	WORD GAMES
CAREER EDUCATION	PHYSICAL EDUCATION	HEALTH	AWARDS
MOTIVATION	MUSIC	ART EDUCATION	CLASSROOM ENVIRONMENT

GOOD APPLE MIGHT HAVE JUST THE VERY BOOK YOU HAVE BEEN LOOKING FOR!

★ **RECORDS – CASSETTES** . . . a dozen favorites with accompanying activity books.
★ **ACTIVITY POSTERS** . . . over 30 titles each 17" x 22". Your students will love to complete them.
★ **NOTE PADS** . . . 2 dozen choices to reward and motivate. A note for almost every occasion.
★ **OTHER GOOD APPLE PRODUCTS INCLUDE** . . . films, T-shirts, bumper stickers, tote bags, note cards.

☆ ***WORKSHOPS*** . . . Good Apple will provide you with a unique variety of workshops, from gifted education to positive self-concept, from make-it and take-it to major content areas of curriculum. Twenty outstanding consultants are available to meet your needs. All of the Good Apple professionals are experienced teachers and recognized authorities. Our programs include scheduled workshops, special-purpose workshops designed specifically for your school and summer institutes where YOU will be the focus of a 3-5 day involvement experience and have the opportunity for graduate credit. We will work together on providing a workshop to fit your needs! Write to: Good Apple Workshops, Box 299, Carthage, IL 62321-0299 or call Bob Steinman at 217-357-3981.

FOR A FREE CATALOG WRITE: Good Apple, Inc., Box 299, Carthage, IL 62321-0299